United States
Department of
Agriculture

Agricultural
Research
Service

Crop Protection Research

1982 Annual Report

This report is intended for the use of administrative leaders and research workers and is not for general distribution or publication. It should not be cited or filed in libraries.

This publication reports research involving agricultural chemicals. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, beneficial insects, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

Any trade or company names used in this publication are used solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

FOREWORD

Crop Protection

Research included in this report is conducted to improve crop protection technology including biological and chemical methods to control insects, diseases, weeds, nematodes, and other pests while at the same time retaining or improving the quality of our environment.

New multidisciplinary concepts for pest management and control include the development and integrated use of conventional pesticides; behavior control chemicals such as pheromones and attractants; genetic techniques, parasites, predators, pathogens, and weed-feeding insects; disease and insect resistance in host plants and plant growth chemicals.

The research workers in the Agricultural Research Service (ARS) publish the results of their investigations in the open literature as quickly as sound scientific judgment warrants. This is an administrative report to provide for those interested in the results of this work a brief overview of the scope of the activities and examples of recent findings, some of which still have not been released by publication. No attempt is made at completeness.

This report outlines crop protection research and provides a brief description of recent accomplishments at the various locations throughout the United States. The report is organized by ARS National Research Programs, each of which describes a separate subject matter area. The ARS National Research Programs are subdivided into Technological Objectives which more specifically describe the objectives of each area of research.

Readers who have comments or inquiries are invited to contact either the National Program Staff or, more appropriately, scientists at the locations where the research is conducted.

Edward B. Knipling

EDWARD B. KNIPLING
Associate Deputy Administrator
Plant and Natural Resource Sciences Staff

TABLE OF CONTENTS

SUMMARY

Crop protection research is an integral part of the total research program in the Agricultural Research Service. The research is described under eight National Research Programs (NRP) and three Special Research Programs (SRP). A brief summary of each NRP and SRP is provided in the front of this volume. More detailed reports for each NRP and SRP follow with selected examples of progress and publications.

NRP 20220 Insect Control - Horticulture Crops

Fruits, vegetables, nut-crops, and ornamentals are valued at about $17.3 billion. About 12% or about $2.1 billion a year is lost in yield and/or quality of these horticultural crops to insect and mite pests. The research develops pest control technologies to reduce or eliminate these losses and be compatible with the environment. The research also develops pest control technologies in support of action agency programs (APHIS) to help them contain or eliminate exotic pest introductions such as the Mediterranean fruit fly , Oriental fruit fly, melon fly, and Mexican fruit fly that are a constant threat to the horticultural crops grown on the Continental U.S. A major emphasis is given to area-wide suppression techniques to eliminate as pests the citrus black fly, Caribbean fruit fly, and West Indian sugarcane rootstalk borer weevil.

The program is currently conducted at 16 locations by 50 scientists with a total budget of about $8 million. The results of this research are reported in scientific journals at a rate of over 100 publications per year.

Predacious mites help reduce early generations of citrus thrips and eliminate insecticide sprays to maintain the biological control programs on California red scale and other scales. Pheromones were used to delineate populations of California red scale so that insecticide applications can be applied in a more judicious manner to prevent the upset in the natural balance of parasites and predators. A pheromone trap was developed for the West Indian sugarcane rootstalk borer weevil to provide better detection for this pest of citrus.

Vetch cover crops in irrigated pecan orchards were useful to build up parasite and predator populations for pecan aphid control. This reduced early season insecticide control of pecan aphids. The vetch also aids in soil moisture retention in the summer and helps control weeds and is a fair crop for honey flow and a potential seed or forage crop. It also provides erosion control of orchards in the winter.

The Department of Food and Agriculture, State of California, was able to develop mass rearing facilities for over 100 million sterile medfly pupae/week using ARS technologies. These flies were used to help eliminate the pest from the State in the medfly campaign.

Savings in insecticide use as great as 72% were obtained when an automatic intermittent sprayer was used to apply acephate to peppers as compared to sprays applied with a conventional sprayer. The quality and quantity of fruit and

control of European corn borer and green peach aphid were equal to the conventional sprayer.

Sweetpotato breeding lines with resistance to 10 species of soil insects were identified. Several of these lines have strong potential for release and will prove to be a viable alternative to insecticides for insect control.

Use of color infrared aerial photography was developed as a tool in surveying the spread and/or decline of diseases. This tool was used to identify root rot and white rust and will assist growers in identifying infestations at levels warranting initiation of fungicide treatments.

NRP 20230 Cotton and Tobacco Insects

The National Research Program on Cotton and Tobacco Insects involves research that will result directly or indirectly in the development of new and improved practices for reducing losses caused by insects attacking cotton and tobacco. Research is conducted within five major thrust areas: (1) develop fundamental knowledge of biology and ecology, (2) develop principles of host-plant resistance, other host-pest interactions and cultural approaches, (3) develop principles of biological control including autocidal methods, (4) develop principles of chemical control methods, including insect growth regulators and behavioral chemicals, and (5) develop principles for integrating methods into systems and systems into strategies appropriate for use on crops grown in cotton and tobacco agroecosystems. Research is conducted by about 60 scientists at 10 locations throughout the southern United States from Oxford, North Carolina, to Brawley, California. Research contributing to this National Research Program is also conducted in three foreign countries.

Genetical characterization of selected boll weevil strains, additional quantitative information on diapause and dispersal of the boll weevil and the bollworm, and the physiological characterization of diseased bollworms were obtained for use in designing improved insect management programs. Increased concentrations of anthocyanin in cotton plants was demonstrated to be a source of host-plant resistance for the tobacco budworm. Parasites of both the egg and nymphal stages of lygus bugs was demonstrated to significantly reduce populations and an improved sterility method for the boll weevil was developed by utilizing new synthetic insect hormones.

An attracticide containing a commercial adjuvent, the pink bollworm pheromone, and pyrethroid insecticides, produced over 90 percent mortality of pink bollworm adults. The number of insecticide applications have been reduced by over 70 percent on over 40,000 acres of cotton by boll weevil eradication and improved management of the bollworm and tobacco budworm; over 10 applications were used in 1978 prior to eradication and less than 3 applications were used in 1981 after eradication.

Future activities will continue to be conducted under the five major thrust areas. However, initial actions will be taken to increase efforts on biology and ecology to obtain fundamental knowledge needed to integrate control methods into improved systems and to select the most appropriate control strategies.

NRP 20240 Insect Control - Grains, Forages, Sugar Crops, and Oilseeds

The primary objective of this National Research Program is to develop new and improved control methods, tactics and strategies to reduce insect related losses of corn, small grains, sorghum, grass and legume forages, sugarbeets, sugarcane, soybeans, peanuts, sunflowers, and other field crops. This research is a part of the cooperative effort by Federal, State, and industry scientists to provide the knowledge needed to protect more than 300 million acres of field crops and one billion acres of grazing land from insect depredations.

The National Research Program is conducted in cooperation with 23 State Agricultural Experiment Stations and is responsible to the research needs identified by industry. The program is currently conducted at 24 locations by 63 scientists operating on a total budget of about $7-1/2 million. The results of this research were reported in scientific journals at a rate of over 100 publications per year.

Control approaches in which significant progress was reported in 1981 include biological control, host-plant resistance, cultural practices, and chemical control. Also, significant progress was reported in the development of attractants, the development of economic injury levels and monitoring methods for integrated management systems, information on biological and ecological studies of pests and beneficial insects, and the use of radar to study insect migration.

Some of the significant accomplishments in host-plant resistance were the registration of wheat germplasm and varieties with insect resistance and the registration of corn and alfalfa with resistance to insects. Further progress was made in the selection and development of sorghum germplasm with resistance to biotype E greenbugs; pearl millet resistance to chinch bugs; wheat with resistance to Hessian fly; Bermudagrass with resistance to the fall armyworm; and sunflowers with resistance to the sunflower moth. A few of the significant accomplishments in biological control included the development of information regarding the presence of a marking pheromone in larval frass of the corn earworm, the development of sex attractant for the sunflower moth and the beet armyworm, the discovery of the role of parasites in regulating stinkbug populations, and the release of a new parasite of the sugarcane borer.

Other research in support of the development of pest management systems included documentation of extended flights of corn earworm and fall armyworm through the use of radar; the use of insecticides applied to irrigation water to protect second crops of corn in double cropping systems; use of radiation to reduce the reproduction of fall armyworms; use of seed treatment in corn to reduce black cutworm feeding; studies on the biology of the corn rootworm to support pest management systems; and economic threshold data on the threecornered alfalfa hopper on soybeans, chinch bugs on sorghum, greenbugs on wheat, the alfalfa blotch leafminer on alfalfa, and black grassbug on rangeland grasses.

NRP 20250 Basic/Noncommodity Research for Insect Control

The following are significant advances that contribute to the objective of selective disruption of insect growth development and reproduction:

- A sibling-selection procedure was used to successfully develop a strain of boll weevil that can tolerate the somatic effects of sexually sterilizing doses of ionizing radiation.

- Cell lines were obtained from imaginal discs of three species of moths. The cell lines have retained the ability to respond to insect hormones.

- Makisterone A is the major molting hormone in the milkweed bug and other Pentamorpha species.

- Ecdysteroid biosynthesis was discovered in the testes of Heliothis.

- An ovarian hormone was shown to be necessary for pheromone production in house flies.

- Storage of uric acid in fat body cells of tobacco budworm was induced by 20-hydroxyecdysone.

The following are significant advances that contribute to the objective of devising new principles of insect control based on behavior and ecology:

- Sex pheromones were isolated, identified, and synthesized for the western grapeleaf skeletonizer, velvet bean caterpillar, southern corn rootworm, western bean cutworm, bagworm, and Mexican fruit fly. The hair pencil pheromone was identified for tobacco budworm.

- Application of the plant growth regulator chlormequat chloride to seedlings of a greenbug-susceptible sorghum line resulted in resistant mature plants.

- The sex pheromone of the corn earworm, Heliothis zea, dramatically increased parasitization of its eggs by Trichogramma wasps.

- Behavioral studies revealed that capture of Tephritid fruit flies is likely to be enhanced by a striped fluorescent color pattern and an adhesive undersurface.

- A gas chromatography-mass spectroscopy procedure was developed for the identification of the double-bond position in nanogram quantities of long-chain alcohols and acetates.

The following are advances that contribute to the objective of developing new principles and practices in insecticide use:

- Fifty-three new candidate chemicals for insect control were received for research evaluation from industrial laboratories.

- Ethylene dibromide residues in treated grapefruit fell from initial levels of 2.7 to 24.1 ppm to non-detectable levels after 3 weeks of aeration.

- Disposable water-adsorbent extraction columns can replace the liquid-liquid extraction cleanup step in residue analysis for pesticides.

- d-Phenothrin formulated as a 30% silica gel or diatomaceous earth dust is effective for disinsection of aircraft.

- Aldicarb persists in crop foliage, which when plowed back into the soil may lead to residues in certain crops planted the next year.

NRP 20260 Biological Agents for Pest Control

Research in NRP 20260 is concerned with (1) the control of agricultural pests by the use of natural enemies and (2) taxonomic research related to arthropods. The more than 70 scientists associated with this program, located in 18 laboratories in 10 States and at four overseas research laboratories, direct their research efforts to the many facets of biological control. These researchers produced 175 publications in recognized journals and other avenues of publication. In addition, there are 27 SY's devoted to taxonomic research at the Systematic Entomology Laboratory in Beltsville/Washington.

Key events within this NRP include the receipt of over 100,000 specimens of beneficial natural enemies at our quarantine labs from more than 20 countries throughout the world, including about 25,000 specimens from overseas ARS laboratories. These were obtained for study and release against 30 to 40 target weed and insect pests within the United States. Control of the alfalfa weevil, alfalfa blotch leafminer (a fly), and musk thistle by exotic organisms have yielded and will yield millions of dollars of benefits to agriculture in the United States. The use of native pathogens against sicklepod is an example of a new concept of biological control that has a tremendous economic potential. Insects have been and are being introduced to control Russian thistle, Canada thistle, musk thistle, yellow starthistle, leafy spurge, and insect pests such as the devastating Colorado potato beetle. These examples of classic biological control are mainstays of the program.

The use of insect pathogens is developing rapidly and offer tremendous potentials. The bacterium Bacillus thuringiensis has proven to be a species of tremendous variability with considerable potential. Genetic manipulation of bacteria through the exchange of genetic information may lead to more effective pathogens with wider ranges of target organisms.

ARS taxonomists continue to produce scientific publications arising from their research efforts with countless species of insects and arthropods. These publications permit scientists throughout the United States and in many parts of the world to conduct research that without definitive identification and classification of the organism being studied would be impossible. In 1981, the Systematic Entomology Laboratory gave authoritative identifications of 114,000 specimens for scientists in ARS, APHIS, FS, and state, private, and foreign agencies, in addition to their research efforts.

NRP 20270 Crop Disease Control and Noncommodity Research on Plant Pathogens and Nematodes

Scientists in this program explore basic aspects of plant disorders to gain fundamental knowledge and new approaches in the control of plant nematodes and pathogens. This information undergirds all applied commodity-oriented disease/nematode control programs.

Relatively new trends and areas of research include the following: Application of pesticides via irrigation water; reduced use of chemicals made possible by changing cultural practices; a greatly increased program on biological control of diseases and nematodes; genetic engineering as an approach to disease control; the development of extremely sensitive tests to detect latent pathogens in plants and seeds, especially viruses and viroids; the biochemical mechanisms of resistance or susceptibility between host and parasite; the influence of mycorrhiza on plant growth and health; and interactions of pathogens--especially those in soils--and their effects on crops. The importance of these lines of reseearch will continue in the forseeable future.

Much concern about a number of disease/nematode problems has developed during the year. Some of the problems are--the increasing resistance of widespread pathogens to fungicides; the widespread occurrence of the pinewood nematode and the millions of trees it has killed in the United States; the destructive and spreading wilt disease of alfalfa caused by Verticillium fungus; the loss of registration on one of the most effective and widely used nematicides in the United States (DBCP) and the impact this loss may have on crop losses; Karnal bunt disease in wheat in the West, the corn cyst nematode in Maryland, and a new, previously unknown disease of potatoes in Nebraska; and disease problems of new dimensions that are emerging as a result of minimum tillage practices.

Significant progress was made in several lines of research. Some examples are as follows: A computer-based system was developed that permits prediction of rust-resistant genotypes of wheats; cultural practices were developed that suppress several serious diseases/nematodes: for example, plowing beans to a depth of 9 inches suppressed damping-off and blight diseases and the growing of golden nematode-resistant cultivars of potatoes alternately with nonhost crops and using minimal nematicides suppressed the density of golden nematode to a level below which it did not spread; many previously unknown bacteria and fungi were discovered that are highly antagonistic to major fungus pathogens and nematode pests of dozens of crops; soil fumigation with simultaneous irrigation greatly increased yields over those resulting from the use of fumigation alone (for peaches--by $800/acre gross, and for peanuts, by 50%). The combination gave excellent control (90% of a lettuce disease) with only one-fourth the amount of chemical required when fumigation, alone, was used. Nematodes were suppressed to below damaging levels, even with intensive cropping systems and without chemicals, by cultural practices such as rotation of specific crops; germplasm was found, or new cultivars were developed, of several crops with resistance to major pests (e.g., soybeans resistant to the rust disease or the cyst nematode; wheat, to the root-knot; and cotton, to the reniform nematodes; and papaya, to ringspot virus); a new kind of serological procedure that involves hybridoma cells from mice was developed that permits highly specific studies on plant virus relationships; unusual disease agents such as merithmid

nematodes, cyst nematodes, biocontrol fungi, and certain spiroplasmas were cultured *in vitro*, a result that allows their detailed biochemical study, mass production, study in countries where they do not occur naturally, and such other advantages as elucidation of their detailed interactions with host plants; new genetic engineering technology was developed by which plant viroids can be quickly detected directly in plant saps; comprehensive taxonomic studies were completed and monographs published that deal with the brown rotting fungi of fruit crops, the spectrum of cyst nematodes, and the large fungi of the National Parks; compounds were found that affect the germination of fungal spores and of weed seeds--some inhibited germination of one or both and others stimulated the germination of one or both. Some of these compounds have excellent potential for use in the biochemical control of diseases and weeds. Many new applications of radiation technology were developed--gamma irradiation of wheat, plus selective breeding, likely will result in a wheat with universal resistance to leaf rust, and ultraviolet light treatments resulted in a biotype of fungus that was highly effective in controlling Fusarium disease of mums.

Dozens of additional examples of accomplishments of fundamental nature could be given. These findings are the result of the work of 64 scientists at 27 domestic locations and whose work is categorized into 85 in-house projects. This NRP also supported 35 cooperative extramural projects that involve 45 State scientists in 22 States and 7 PL 480 projects by 11 foreign scientists in 6 countries. Progress was reported in 105 refereed publications during 1981.

NRP 20280 Weed Control Technology for Protecting Crops, Grazing Lands, Aquatic Sites, and Noncropland

In 1981, progress was reported in more than 135 scientific publications. This included developing an understanding of the germination of seeds, growth, reproduction, allelopathic relationships, competitiveness with crops, and determining the vulnerability of weeds to control in relation to development of weed control technology. The discovery of allelopathic effects and the effects of naturally occurring secondary chemicals in weeds and crops provides new approaches for developing weed control technology. More than 65 new chemicals were evaluated for their weed control effectiveness and safety in about 70 crops, aquatic sites, and rangelands. Controlled-release technology for herbicides was improved in 1981. Progress in understanding the penetration, absorption, translocation, sites and mechanisms of selective action, and metabolic fate in plants, soil, water, and the environment has increased the performance efficiency and safety of herbicides.

Several new plant pathogens were discovered as having potential for weed control and some are now registered for widescale use in rice, soybeans, and other crops. More than 20 species of insects are being evaluated for weed control in crops, rangelands, and aquatic sites. Unique herbicide application equipment, such as the rope wick applicator, recirculating sprayer, endless belt applicator, and roller wipers, that reduces drift and applies herbicides to weeds in crops without getting the herbicides on crops or soils is being developed and several designs are in widescale use. Outstanding progress was made in developing new weed control components technology that will increase the effectiveness and safety of integrated weed management and pest management

systems. The development of improved and new chemical weed control practices and their use in integrated weed and vegetation management systems is enhancing revolutionary advances in reduced tillage, minimum tillage, no-tillage and conservation tillage crop production systems. These systems are increasing crop yields, lowering production costs, reducing the use of energy, increasing water use efficiency, and reducing soil erosion.

The research in NRP 20280 develops technology for increasing and improving efficiency of food, feed, and fiber production. This NRP supports the research, extension, and education mission of Science and Education (S&E) USDA; the provisions of the Federal Noxious Weed Act of 1974 (FNWA) - administered by the Animal and Plant Health Inspection Service (APHIS); Federal Seed Act - administered by the Agricultural Marketing Service (AMS); and the operational programs of the Soil Conservation Service (SCS), Rural Electrification Administration (REA), Forest Service (FS), Federal Grain Inspection Service (FGIS), Agricultural Stabilization and Commodity Service (ASCS), and other agencies of the U.S. Department of Agriculture. It also aids in meeting the pesticide registration requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), administered by the U.S. Environmental Protection Agency (EPA); and operational programs of the Tennessee Valley Authority (TVA); Food and Drug Administration (FDA); Drug Enforcement Administration (DEA); Department of Defense (DOD); and five agencies of the U.S. Department of the Interior; and other Federal agencies.

NRP 20290 Agricultural Chemicals Technology for Crop Protection and Modification

Progress in 1981 was reported in 47 scientific publications. More than 120 new chemicals were evaluated for their effectiveness and safety as herbicides, fungicides, nematicides, insecticides, and plant growth modifiers. Improved methods were developed for the synthesis of strigol, the stimulator of witchweed seed germination. The larger quantities of strigol and newly synthesized related chemicals expected to be available in 1983 will facilitate field evaluation research to develop improved witchweed control technology and to determine the effects of strigol and related chemicals on the germination of other weed seeds.

Outstanding progress was made in improving techniques and systems for the discovery, evaluation, and development of new, improved, selective, biodegradable, and safe pesticides and plant growth modifiers. Progress was also made in developing a basic understanding of their penetration, absorption, translocation, sites of action, mechanisms of action, role of membranes in herbicidal action, and their metabolic fate and effects in plants, soil, water, and other components of the environment. Improved application technology and controlled release formulations of agricultural chemicals were evaluated that will increase their performance effectiveness and safety, reduce the need for excessive use, and reduce the risks to nontarget organisms and other components in the environment.

Basic research to identify, characterize, and synthesize secondary chemicals in weeds and crops that cause allelopathic effects is providing fundamental

information on the basis for competition among weeds and desirable plants and on new approaches to weed control. Basic research on surfactants, protectants, and other additives in agricultural chemical formulations is providing fundamental information that can be used to optimize residual activity, penetration, absorption, and translocation, stability in formulations, and to aid in better understanding the metabolism and fate of agricultural chemicals.

The research in NRP 20290 develops technology for increasing and improving the efficiency of food, feed, and fiber production. The extension and education programs of the Science and Education (S&E) USDA; the Federal Noxious Weed Act of 1974 (FNWA)-- administered by the Animal and Plant Health Inspection Service (APHIS); and the Federal Seed Act-- administered by the Agricultural Marketing Service (AMS); and the operational programs of other agencies of the U.S. Department of Agriculture. It also aids in meeting the pesticide registration requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), administered by the U.S. Environmental Protection Agency (EPA); and the operational programs of the Tennessee Valley Authority (TVA); Food and Drug Administration (FDA); Drug Enforcement Administration (DEA); Department of Defense (DOD); five agencies of the U.S. Department of the Interior (USDI); and other Federal agencies.

SRP Integrated Pest Management Systems

This SRP focuses on the systems approach to integrating advanced proven technology into more cost effective, environmentally acceptable, and energy conserving pest management. This SRP was established to: (1) strengthen coordination of IPM systems research conducted in SEA/AR, (2) further increase use of the systems approach in pest management research, and (3) provide a more viable point of contact for U.S., foreign, and international organizations interested in SEA/AR research on IPM systems.

The SRP encourages cooperation not only with ESCS, APHIS, Extension, and Universities, but also private industry and NASA, NOAA, DOD, etc. Research results and knowledge applicable to IPM systems include pest biology and ecology, individual control components, models of commodity growth and pest population changes, electronic technology (computers, electronic pest detection methods, meteorological survey systems, aircraft and satellite data acquisition methods, etc.), economics, and systems research.

The Administrator of ARS has established an annual allocation of $1.1 million to fund this Program. Now in its third year, the Program consists of five multidisciplinary projects each of 3-5 years' duration. Each project is described herein.

SRP Minor Use Pesticides

A major emphasis of this program is to assure that pesticides for minor and special uses are available to the agricultural community. These minor-use needs are identified through extension, research, and the agricultural community. For various reasons, but primarily because of lack of economic

incentive, the chemical industry is unwilling to develop the data for registration of pesticides for minor uses.

The ARS program has 29 scientists involved in the program at 17 locations. During 1981, they cooperated with 21 state scientists to develop data on 82 food-use requests and 471 ornamental-use requests. This research was supported at the level of $.91 million in 1981.

The cranberry industry estimates that a method developed for use of glyphosate in a belt-wiper application to control weeds in cranberry bogs increases yield by more than 10% and return from the crop by about $15 million per year.

SRP Pilot Testing of Alternative Methods of Pest Control

The Administrator of ARS has established a rotating discretionary fund of roughly $1.6 million to support a developmental research program on alternative methods of pest control. The purpose of the fund is to enable scientists to conduct the developmental research needed to determine whether an emerging of a potential pest control technology is either technically feasible (Category I) or technically and economically feasible (Category II) for implementation by the private or public sectors. Thus, the primary intent of the Program is strongly to develop potential alternatives to the sole reliance on broad spectrum pesticides. The funds are not to be used to shore up ongoing base programs.

Most pilot research projects are conducted with a strong inhouse component, and this is particularly true if the project will have to be followed with additional research. All projects involve developmental research on alternatives to sole reliance on broad spectrum chemical pesticides for managing insects, nematodes, weeds, and plant pathogens which cause losses during production, and in postharvest processing and handling. However, proposals are not included in this program if they focus on control methods for other classes of pests such as vertebrates and microorganisms which cause animal or human diseases. The use of broad spectrum pesticides is included in projects if appropriately integrated with alternative control methods. The status of 20 projects is described.

National Research Program 20220

INSECT CONTROL - HORTICULTURAL CROPS

Technological Objective: New and improved methods to reduce losses caused by insects and mites to fruits, vegetables, nut trees, and nursery stock.

This National Research Program is composed of seven subelements with the collective objective of providing through research new or improved methods for preventing the losses to horticultural crops that are caused by insects and mites. The program subelements are identified as the control of insect pests of citrus, tropical and subtropical fruit, pome fruit, stone and small fruit, tree nuts, vegetables, shade trees, and nursery, ornamental, and other horticultural crops. Providing technology for protecting horticultural crops from insects and mites is an essential component for the production of steady, reliable, and safe supplies of these crops that are reasonable in cost to the consumer, yet profitable to the farmer.

NPS Contact: P. H. Schwartz

Research Locations:

Riverside, California
Miami, Florida
Orlando, Florida
Byron, Georgia
Honolulu, Hawaii
Kimberly, Idaho
Vincennes, Indiana
West Lafayette, Indiana
Beltsville, Maryland
Wooster, Ohio
Corvallis, Oregon
Charleston, South Carolina
Brownwood, Texas
Weslaco, Texas
Yakima, Washington
Kearneysville, West Virginia

Examples of Recent Progress:

Phytoseiid mite shows potential biological control of citrus thrips - Riverside, California. The phytoseiid mite, Euseius hibisci can regulate the injurious early generations of the citrus thrips. Upwards of 2000 acres of citrus in the Corona foothill area of Southern California were not sprayed for citrus thrips. Also, the natural resistance to insecticides by E. hibisci was found from the San Joaquin Valley. Where California red scale is not under adequate biological control and requires insecticide treatment, a resistant strain of the mite may still be effective in controlling thrips.

Pheromones of California red scale fits into integrated pest management programs for citrus - Riverside, California. Pheromone traps are used to detect incipient infestations, map infestations within orchards, monitor seasonal appearance of the males, time insecticide applications, check insecticide efficacy, predict injury levels and experimentally control scale populations by removing males. Those applications of the pheromone facilitate accurate and efficient management of scale populations without unnecessary use of insecticides and do not disturb the insect's natural enemies. Such ecologically oriented approaches should help preserve the environment, conserve natural resources, and reduce costs of citrus produce to the consumer.

Findings aid in the development of a sound IPM system for vegetable production, reduce the use of pesticides, and reduce virus vector population - Riverside, California. Recent discovery of resistance to virus infection by Aphis gossypii among our aphid-resistance breeding lines and subsequent demonstration of the use of this resistance to infection will enhance the probability of retaining this important quality in our combined insect and disease resistance muskmelon breeding program. Among the Cucurbita pepo cultivar types field tested, those most resistant to squash bugs were the most susceptible to the leafminer and those most resistant to the latter were the most susceptible to the former.

Trap and pheromone should facilitate survey and detection of citrus root weevil - Orlando, Florida. Development of a trap and demonstration of a pheromone in frass of D. abbreviatus provide basic requirements for developing a method to detect and survey populations of this weevil. Prior to this development, surveys for the weevil were limited to visual inspection for the weevil or its damage.

Two entomogenous nematodes are candidates for biological control of citrus root weevils - Orlando, Florida. Detection and identification of two nematodes pathogenic to citrus root weevils provide a strong lead in developing biological controls. The two nematode species were recovered from numerous sites in Florida and can be cultured either on artifical media or in living insects. Within a relatively short time, large numbers of nematodes could be reared and evaluated as possible agents for biological control.

Insect rearing established at Byron - Byron, Georgia. During 1981, rearing programs were initiated for the lesser peachtree borer, peachtree borer, and plum curculio. The insects are reared on thinning apples and artifical diets and are used in other entomological programs in support of fruit and nut research.

Possible oviposition stimulant for peachtree borer is extracted - Byron, Georgia. Peachtree borer (PTB) cocoons, peachtree bark and a mixture of frass and gum obtained around PTB wounds were extracted with organic solvents of increasing polarity. Among the filter paper substrates, female PTB moths laid more eggs on those treated with acetone extracts of peachtree bark and of the frass and gum mixture than on others. A 30% acetonitrile fraction of the acetone extract of the gum and frass mixture had the greatest biological activity. Active fractions from bark, cocoons, and gum and frass mixtures apparently have a common substance(s), as demonstrated by bioassay and TLC, that stimulates ovipositing of female PTB. Isolation and identification of the stimulant( ) could provide useful materials for monitoring PTB and, perhaps, for developing peach cultivars resistant to PTB.

Blackmargined aphids reduce tree growth and carbohydrate reserves - Byron, Georgia. A brief infestation of the blackmargined aphid, M. caryella, can reduce growth and carbohydrate reserves of mature pecan trees in the field. This alteration of the tree biochemistry suggests that pecan aphids might be a major factor in reducing carbohydrate reserves and contribute to the irregular-bearing problem of pecans.

A new pest threatens Georgia pecans - Byron, Georgia. An undescribed species of Phylloxera was found on mature pecan cultivars in Central and South Georgia in 1981. The species is presumed to be the same one that has infested mature Pabst cultivars for many years and was generally believed to be Phylloxera notabilis Pergande, a common pest of nursery pecans and young seedlings. Each year, infestations of the undescribed species on Schley and Stuarts have increased in numbers. A survey of mature Schley, Stuart, and other cultivars from across the state indicates that the undescribed species is now found in all of the pecan-growing areas of Georgia. The life history of the species was described. Dr. Manya Stoetzel, Beltsville, MD, described the morphology of the species and named it Phylloxera russellae (Stoetzel).

Vetch cover crops in irrigated pecan orchards to produce beneficial insects for pecan insect control - Byron, Georgia. Research from laboratory experiments and small field plots shows that a predator of pecan aphids on legumes can be produced. With the native aphid predator, the convergent lady beetle, Hippodamia convergens, a biological control system for pecan aphids was developed. The convergent lady beetle reproduced in large numbers on the pea aphid, Acyrthosiphon pisum (Harris), that infests vetch but does not feed on pecan trees. In the spring two generations of convergent lady beetles develop on pea aphids on vetch, then migrate into pecan trees. There, they biologically control three species of foliar feeding pecan aphids, the blackmargined aphid, Monellia caryella (Fitch), Monelliopsis nigropunctata (Granovsky) and the pecan aphid, Melanocallis caryaefolia (Davis). Convergent lady beetles are stimulated to move into pecan trees by the presence of pecan aphids and honeydew on the foliage and by the decline of pea aphids on dying vetch. Vetch is a candidate cover crop for pecan growers who wish to supplement the nitrogen supply to their trees and to improve the condition of the soil in the orchards. Vetch retains soil moisture, controls weeds, is a fair honey flow crop for beekeepers, is a potential seed or forage crop, and controls erosion in winter.

Medfly production can be automated without loss in insect quality - Honolulu, Hawaii. A prototype conveyor belt system that electrically meters fruit fly eggs onto diet medium, which is mechanically pumped onto a movable conveyor belt, was designed and successfully tested. The technique reduced by 80 percent the hand labor required to spread medium into plastic trays, hand apply eggs, and stack the hundreds of trays that are used weekly. A modified system in which larvae emerge naturally from the growth medium and pop out of the trays, will be tested in cooperation with scientists of the APHIS/PPQ Methods Development staff, who offered a mockup of the modified system.

California develops facilities for rearing 100 million sterile fly pupae/week on basis of technology used at ARS Tropical Fruit and Vegetable Research Lab - Honolulu, Hawaii. In less than 6 months, the Department of Food and Agriculture, State of California, renovated vacant warehouses and began shipping sterilized insects to San Jose through direct assistance from the ARS laboratory at Honolulu. Personnel were trained, seeding stocks (eggs and pupae) were supplied, and irradiation procedure was developed for the 5-fold scale-up of the ARS rearing system. Insects grown under this temporary arrangement now are used in Central America and in the Kula Sterile Insect Release Project in Hawaii. This response to the 1981-1982 emergency illustrates the need for standby facilities on American soil, where the research base exists, to protect the 2 billion dollar U.S. industry that is threatened by introductions and to provide proven technology to other nations.

Correction of acidic atmosphere in mass-rearing facility improved working conditions and curbed corrosion of metal equipment - Honolulu, Hawaii. During the production of large numbers of insects for the sterile fly release program in California, excessive fermentation in the media, produced high levels of volatile acids. The acids irritated workers' eyes and corroded metal so quickly that air conditioners had to be replaced every 3 months. Related problems were encountered in the Metapa, Mexico Medfly facility, where air in the building must be exchanged 6 times every 10 minutes. The immediate problem of excessive fermentation was solved by lowering the pH of the medium by addition of acidulants. The effects of pH on mass-produced insects are being assessed in detail.

System completed for striped cucumber beetle rearing - Vincennes, Indiana. The system developed for rearing striped cucumber beetles allows production of sufficient eggs, larvae, and adults to support all host-plant resistance studies in the laboratory and field. The system also allows production of sufficient beetles for laboratory studies in biology, ecology, and control.

National Muskmelon Research Group is initiated - Vincennes, Indiana. The National Muskmelon Research Group, composed of researchers from various disciplines and locations within the U.S., has now progressed to the point where selection programs can be initiated. Selection will be made at 6 geographical locations (both spring and fall crops) with two generations of breeding each year, providing a potential to release combined resistance germ plasm to the vegetable industry by 1985 or 1986.

Insect- and disease-resistant apple germplasm developed through breeding - West Lafayette, Indiana. Fruit free of insect and disease damage were produced without chemical sprays by progenies (trees) from 6 of the initial crosses in 1974. Of the 6 progenies (19 trees) with fruit, 3 progenies (5 trees) produced fruit free of both insects and disease. The numbers of fruit from these 5 trees ranged from 1-12, with a size of fruit ranged from 1" to 3 1/2" in diameter. Some of the fruit had horticulturally acceptable characteristics.

Female sex pheromone of the bagworm Thyridopteryx ephermeraeformis (Haworth) was confirmed - Beltsville, Maryland. Through a series of chemical analyses and a previously developed field bioassay method the pheromone was identified as 2-pentyl decanoate (=1 methyl butyl decanoate). Field tests with the (+) and (-) enantiomers and racemate form showed that the (-) is the active component and the (+) is non-inhibitory. The (-) and racemate were equally attractive at comparable enantiomer rates. Male response to sticky traps baited with the synthetic sex lure confirmed that the deciduous setae shed by the female from the thorax and the partial abdominal segment I are sources of the pheromone. Scientists in the Organic Chemical Synthesis Laboratory, AEQI, cooperated in the work.

Losses in tomato yield resulting from nine population levels of the Colorado potato beetle are determined - Beltsville, Maryland. Determinate cvs sustain beetle population levels as high as one pair of beetles per 20 plants at the beginning of the growing season without significant loss in weight or number of fruit. Indeterminate cvs. could withstand initial infestation of only one pair per 165 plants. The information on response of yield to infestation will enable growers to decide more accurately if and when to apply control measures.

Insecticide needed to control pests of peppers reduced by improved scheduling and use of an intermittent sprayer - Wooster, Ohio. Use of an automatic intermittent sprayer to apply acephate to peppers once every 2 weeks at the recommended rate (0.84 kg. AI/ha) or once every week at half of this rate, saves as much as 72% of the insecticide used in regular weekly sprays applied with a conventional sprayer. Quality and quantity of fruit harvested were equal to those of fruit harvested after conventional spraying, and the modified applications gave equally effective control of the European corn borer and green peach aphid.

Important parasite of the Japanese beetle rediscovered in Connecticut - Wooster, Ohio. A thriving colony of Hyperachteina aldrichi, an important tachinid fly parasite of the Japanese beetle was recently located in Connecticut. This fly is the single most important parasite of the beetle in Japan and, despite indications of successful colonization in the U.S. during the 1930's, had not been observed for more than 30 years. The recently discovered colony has already supplied parasites for release at 4 locations in Ohio and it is expected to furnish parasitized beetles for release in several additional states.

Insect-resistant lines of sweet potatoes identified - Charleston, South Carolina. Identification of sweet potato breeding lines with resistance to most of the major soil insects (10 species) is a major step in developing insect-resistance crops. Several of these lines have strong potential for release and should offer a viable alternative to insecticides for insect control.

Procedures for rearing pickleworms improved - Charleston, South Carolina. Techniques were developed to reduce by 80% the labor required in rearing the pickleworm. This improvement is very important to programs using large numbers of pickleworms for control studies.

Intensive 4-year study on population dynamics of citrus blackfly is completed - Weslaco, Texas. Studies indicate that coexistence between blackfly and the exotic parasite, Prospaltella opulenta, is highly stable at equilibrium densities of ca. 4 blackflies to 1 parasite/1000 leaves. Other parasitic species apparently have been largely displaced by P. opulenta. Life table data representing ca. 50 blackfly generations have been stored on computer disks, and a mathematical model of the blackfly is being developed.

Parasite of the citrus whitefly is established - Weslaco, Texas. Prospaltella lahorensis, a parasite of the citrus whitefly, was introduced into south Texas during 1980 and is now established. The impact of P. lahorensis on its host citrus whitefly is being monitored by population studies, life table analysis and experimental check methods.

Remote sensing developed for surveying for diseases - Weslaco, Texas. Color infrared aerial photography was useful in surveying the spread and/or decline of Phymatotrichum root rot and in monitoring the effects of the fungus as it related to cropping history, weather, and certain control treatments, including preplant anhydrous ammonia applications and salt treatments, as well as other factors such as cropping sequence, rotation, and deep plowing. Aerial photography with color infrared film was used to identify white rust, Albugo occidentalis, infestations at levels warranting the initiation of fungicide treatments in spinach. White rust is the most important fungal disease on spinach in Texas.

Apples and cherries treated by fumigation - Yakima, Washington. Mortality of diapausing larvae (age 4 months) at 23-25°C, 7 days after fumigation with methyl bromide at 56 g/m^3 was only slightly higher than mortality in the untreated control. Fumigation for 2 hr with methyl bromide at 48 g/m^3 at fruit temperatures of 13 and at 64 g/m^3 at 6°C resulted in complete mortality of non-diapausing codling moth larvae in cherries. Fumigation, particularly 72 g/m^3, severely damaged red delicious apples. When cherries were fumigated at 40 g/m^3, inorganic bromide residues ranged from 3.75 to 11.49 ppm. Organic bromide residues ranged from 16.64 to 48.38 ppm immediately after treatment but fell to 0.03-0.39 ppm 2 days after treatment. Dosage-mortality curves for larvae on cherries or thinning apples were established at 6° and 13°C, and did not differ between hosts.

Volcanic ash affects pests of fruit - Yakima, Washington. Ash was on the trees between generations or flights of the codling moth and, therefore, caused minimal damage. Ash shortened adult life and was toxic to neonate larvae. Ash degraded 5 to 20% of the azinphosmethyl applied for codling moth control. Populations of pear psylla receiving minimal amounts of ash continued to expand, but populations receiving heavy ash generally were lowered. Laboratory tests with ash indicated a 70-80% reduction of pear psylla could be expected. Populations of winged predators were decimated.

Black vine weevil controlled on ornamentals - Yakima, Washington. Nurserymen need a method to control the larvae of the black vine weevil, a major national pest of woody ornamentals. The pest is difficult to control because it inhabits the root area below the crown of the plant, thus requiring drenches of potent pesticides. Of 11 candidate insecticides screened, four (carbofuran, oxamyl, bendiocarb, and terbufos) were effective. In additional tests on strawberries, yew, arborvitae, hemlock, and rhododendron, representative woody ornamentals, for efficacy and phytotoxicity data to support registration through IR-4, carbofuran was the most suitable material.

Controlled European asparagus aphid by cultural practices - Yakima, Washington. European asparagus aphid, a newly introduced pest, severely damages thousands of acres of asparagus. In the first year of investigation, the basic biology of the aphids was studied and included, population growth parameters, developmental rates of all life stages, and biology of the overwintering eggs. The rapid spread of the aphid is attributed to its affinity for intense crowding that results in extremely high production of winged forms. Cultural control practice in the autumn that destroyed and/or completely removed the asparagus ferns essentially removed the overwintering eggs.

Insecticide-tolerant population of the green peach aphid evaluated - Yakima, Washington. We substantiated through toxicological studies that the growers' difficulty in controlling the green peach aphid population in Echo, Oregon, in 1980 was due to insecticide tolerance to Monitor rather than to insecticide resistance. Repeated toxicological evaluation of the population through spring-summer of 1981 showed that the population lost much of the insecticide tolerance. The results of our study indicate that insecticide resistance can be delayed by alternating the use of Monitor and Thiodan.

Recommendations improved for control of peachtree (PTB) and lesser peachtree borer (LPTB) - Kearneysville, West Virginia. In nine peach orchards, PTB and LPTB pheromone traps were used to detect insect emergence. First LPTB emergence was April 30 and the first generation peak flight was in late August to mid-September. First PTB emergence was June 11 with the peak in mid-August, and fell to zero by the first week in October. Timing of sprays should be adjusted to improve control of the LPTB. Normal preharvest spray (July 1-15) is too late for the first generation of LPTB and a month in advance of the peak flight of the PTB. The postharvest spray, which is normally applied in late August or early September, would be after the PTB peak flight but would coincide fairly well with the second generation of LPTB. No sprays are currently recommended to cover the first generation of LPTB which occurs in mid-June.

Riverside, California

Bierl-Leonhardt, B. A., D. S. Moreno, M. Schwartz, J. Fargerlund, and J. R. Plimmer. 1981. Isolation, identification and synthesis of the sex pheromone of the citrus mealybug, Plannococcus citri (Risso). Tetrahedron Letters. 22: 389-392.

Coudriet, D. L., A. N. Kishaba, and G. W. Bohn. 1981. Inheritance of Resistance to Muskmelon Necrotic Spot Virus in a Melon Aphid-resistant Breeding Line of Muskmelon. J. Amer. Soc. Hort. Sci. 106(5):789-791.

Oldfield, G. N. and E. C. Calavan. 1981. Stubborn disease in non-rutaceous plants. In: J. Bove and R. Vogel (eds.), Description and Illustration of Virus and Virus-like Diseases of Citrus: A Collection of Color Slides (Rev. ed.) Institut Francais de Recherches Fruitieres Outre-Mer Paris.

Oldfield, G. N., M. V. Reddy, Y. L. Nene, and W. Reed. 1981. Preliminary studies of the eriopyid vector of sterility mosaic. International Pigeonpea Newsletter. 1:25-27.

Roistacher, C. N., E. M. Nauer, A. Kishaba, and E. C. Calavan. 1981. Transmission of Citrus Tristeza Virus by Aphis gossypii Reflecting Changes in Virus Transmissibility in California. Proceeding 8th Conference I.O.C.V., pp. 76-82.

Tanigoshi, L, K. and J. Y. Nishio-Wong. 1981. Greenhouse rearing of citrus thrips Scirtothrips citri for experimental testing. J. Econ. Entomol. 74:213-4.

Orlando, Florida

Beavers, J. B. and W. J. Schroeder. 1981. Effect of Bay Sir 8514 in Diaprepes abbreviatus on citrus in Florida. Fla. Entomol. 64:361-362.

Schroeder W. J. 1981. Attraction, mating, and oviposition behavior in field populations of Diaprepes abbreviatus on citrus. J. Environ. Entomol. 10(6):898-900.

Schroeder, W. J. and W. C. Mitchell. 1981. Marking Tephritidae fruit fly adults in Hawaii for release-recovery studies. Proc. Hawaiian Entomol. Soc. 23(3):437-440.

Selhime, A. G. 1981. Citrus rust mite control. 1980. Insecticide and Acaricide Tests 6:45.

Byron, Georgia

Dutchner, J. D. and J. A. Payne. 1981. Pecan weevil (Curculio caryae, Coleoptera: Curculionidae) bionomics: A regional research project: Miscellaneous publication Entomol. Soc. Am. 12(2): 45-68.

Ferguson, W. L. and J. A. Payne. 1981. Lindane compared with other chemicals for pecan phylloxera control. Pecan South 8(1): 12-19.

Gentry, C. R. 1981. Peachtree borer (Lepidoptera:Sesiidae): Control by Mass Trapping with Synthetic Sex Pheromone. ESA Miscellaneous Publication 12(2): 15-19. 98 pp.

Gentry, C. R., B. A. Bierl-Leonhardt, J. R. McLaughlin, and J. R. Plimmer. 1981. Air permeation tests with (Z,Z)- 3,13-octadecadien-1-ol acetate for reduction in trap catch of peachtree and lesser peachtree borer moths. J. Chem. Ecology 7(3): 575-582.

Gentry, C. R., J. A. Payne, and R. A. Simonaitis. 1981. Soil treatment with aldicarb against several insect pests of pecan. J. Georgia Entomol. Soc. 16(2): 261-265.

Payne, J. A. 1981. Gall Wasp: Status and future studies. USDA-Forest Service, General Technical Report NE-64, American Chestnut Cooperators' Meeting, p. 14.

Payne, J. A., J. D. Dutcher, H. C. Ellis. 1982. Performance of pecan insecticides: past, present, and future. Pecan South 9(1): 23-27.

Stoetzel, M. B. and W. L. Tedders. 1981. Investigation of two species of Phylloxera on pecan in Georgia. J. GA. Entomol. Soc. 16(2): 144-150.

Tedders, W. L. 1981. Report of the spread of an undescribed species of Phylloxera among mature pecan cultivars in Georgia Proc. 74th Ann. Conv. SE Pecan Growers Assoc. 73-76 pp.

Tedders, W. L. and J. S. Smith, and A. W. White, Jr. 1981. Experiment to determine the effects of feeding by Monellia caryella (Fitch) and of simulated honeydew on pecan seedlings in the greenhouse. J. GA Entomol. Soc. 515-517.

Tedders, W. L., J. M. Thompson. 1981. Histological investigation of stylet penetration and feeding damage to pecan foliage by three aphids [Hemiptera (Homoptera): Aphididae]. ESA Mis. Pub. Vol. 12(2):69-83.

Tedders, W. L., C. E. Yonce, and C. R. Gentry. 1981. Feeding by European corn borer on peach trees. J. GA. Entomol. Soc. 16(1):64-67.

White, A. W., E. R. Beaty, and W. L. Tedders. 1981. Legumes as a source of nitrogen and effects of management practices on legumes in pecan orchards. Proc. 74th Ann. Conv. SE Pecan Growers Assoc. 97-106 pp.

White, A. W., Jr., E. R. Beaty, and W. L. Tedders. 1981. Legumes for supplying nitrogen and studies on legumes in pecan orchards. Pecan South 8(4):24-31.

Yonce, C. E. 1981. Pheromone foils peachtree borers. Am. Fruit Grower. 101(4): 14-62. 4 pp.

Yonce, C. E. 1981. Mating disruption of the lesser peachtree borer, Synanthedon pictipes (Grote and Robinson), and the peachtree borer, S. exitiosa (Say), with a hollow fiber formulation. ESA Misc. Publication 12(2): 21-29.

Honolulu, Hawaii

Keiser, I., M. Jacobson, and J. A. Silva. 1981. Optimal formulations with phantolid for extending the duration of effectiveness of trimedlure and methyl (E)-6-nonenoate as attractants to male Meditterranean fruit flies. pp. 245-257. In D. H. Lewis [ed.], Controlled Release of Pesticides and Pharmaceuticals. Plenum Press, New York. 340 pp.

Keiser, I., and N. Wakabayashi. 1981. Fermentation per se as a biological slow delivery mechanism for releasing cofactors of fruit fly attractants. pp. 295-301. In D. H. Lewis [ed], Controlled Release of Pesticides and Pharmaceuticals. Plenum Press, New York. 340 pp.

Little, H. F., R. M. Kobayashi, E. T. Ozaki, and R. T. Cunningham. 1981. Irreversible damage to flight muscles resulting from disturbance of pupae during rearing of the Meditterranean fruit fly, Ceratitis capitata. Ann. Ent. Soc. Am. 74: 24-6.

Nakagawa, S., E. J. Harris, and I. Keiser. 1981. Performance of Capilure in recapturing Mediterranean fruit flies in Steiner plastic or cardboard sticky traps. J. Econ. Ent. 74: 244-5.

Vincennes, Indiana

Dimethoate Assessment Team 1981. The biological and economic assessment of dimethoate, USDA Tech. Bull. No. 1663, 279 pp.

Reed, D. K., T. D. Eichlin, and G. L. Reed. 1981. Effectiveness of blends of synthetic sex attractant and comparison with virgin female lesser peachtree borers as bait for capture of Sesiidae. Environ. Entomol. 10:488-91.

Reed, D. K., M. Jacobson, J. D. Warthen, Jr., E. C. Uebel, N. Tromley, L. Jurd, and B. Freedman. 1981. Cucumber beetle antifeedants: Laboratory screening of natural products. USDA Tech. Bull. No. 1641, Jun. 1981. 13 pp.

Beltsville, Maryland

Argauer, R. J. and W. W. Cantelo. 1981. Stability of Three Ureide Insect Chitin-Synthesis Inhibitors in Mushroom Compost Determined by Chemical and Bioassay Techniques. J. Econ. Entomol. 73:671-674.

Cantelo, W. W. 1981. Control of Sciarid Flies in Mushroom Compost: A Comparison of Several Insecticides. Mushroom News 29(3):20-22.

Cantwell, G. E. 1981. Methods for invertebrates in Staining Procedures 4th Ed. George Clark, Editor. William and Wilins Co., Baltimore, Maryland. Chapter 9. pp. 225-280. (Book Chapter).

Cantwell, G. E. and W. W. Cantelo. 1981. Bacillus thuringiensis a Potential Control Agent for the Colorado Potato Beetle. American Potato J. 58:457-468.

Cantwell, G. E. and T. R. Shieh. 1981. Certan TM - A new bacterial insecticide against the greater wax moth, Galleria mellonella L. Amer. Bee J. 121:424-426 & 430-431.

Fordyce, C. Jr., and W. W. Cantelo. 1981. Techniques to Extract Immature Stages of Lycoriella mali from Mushroom-growing Media. J. Econ. Entomol. 74:253-254.

Neal, J. W., Jr. 1981. Timing Insecticide Control of Rhododendron Borer with Pheromone Trap Catches of Males. Environ. Entomol. 10(2):264-266.

Neal, J. W., Jr. 1981. Effectiveness of Selected Insecticides on Late Instar Bagworm Larvae. J. Georgia Entomol. Soc. 16(3):332-335.

Neal, J. W., Jr. and R. P. Stollins. 1981. Early and mid-season chemical control tests of Eastern tent caterpillar in Maryland. ESA Insect. and Acar. Tests 6:162.

Sanford, L. L., S. L. Sinden, and W. W. Cantelo. 1981. Selecting for Pest Resistance in Early Generations. American Potato J. 58:525.

Wooster, Ohio

Klein, M. G. 1981. Advances in the use of Bacillus popilliae for pest control. In "Microbial Control of Pests and Plant Diseases 1970-1980" (H. D. Burges, ed).Academic Press, London. 949 p.

Klein, M. G. 1981. Mass trapping for Suppression of Japanese beetles. In "Management of Insect Pests with Semiochemicals; Concepts and Practice: (E. R. Mitchell, ed.) Plenum, New York. 514 p.

Klein, M. G., J. H. Tumlinson, T. L. Ladd, Jr., and R. E. Doolittle. 1981. Japanese Beetle (Coleoptera: Scarabaeidae): Response to Synthetic Sex Attractant Plus Phenethyl Priopionate: Eugenol. J. Chem. Ecol. 7(1):1-7.

Ladd, T. L. 1981. Neem Seed Extracts as Feeding Deterrents for Japanese Beetles (Popillia japonica Newman). In "Natural Pesticides From the Neem Tree". Proc.. First Int. Neem Conf. 149-55.

Ladd, T. L., M. G. Klein, and J. H. Tumlinson. 1981. Phenethyl Propionate + Eugenol + Geraniol (3:7:3) and Japonilure: a Highly Effective Joint Lure for Japanese Beetles. J. Econ. Entomol. 74(6):665-667.

Ladd, T. L., D. L. Reichard, and D. E. Simonet. 1981. Integration of a Photoelectrically-Operated Intermittent Sprayer with Action Level Thresholds for the Control of Lepidopteran Pests of Cabbage. J. Econ. Entomol. 74(6):698-700.

McGovern, T. P. and T. L. Ladd. 1981. Japanese Beetle: New Synthetic Attractants. J. Econ. Entomol. 74(2):194-6.

Reichard, D. L. and T. L. Ladd. 1981. An Automatic Intermittent Sprayer. Trans Am. Soc. Ag. Eng. 24(2):893-6.

Charleston, South Carolina

Day, A. and J. F. Robinson. 1981. Comparative Survival, Development, and Fedundity of the Pickleworm Reared on an Artifical Diet and Three Curcubit Hosts. Jour. Ga. Entomol. Soc. 16:518-20.

Elsey, K. D. 1981. Pickleworm: Survival, Development, and Oviposition on Selected Hosts. An. Entomol. Soc. Amer. 74:96-99.

Brownwood, Texas

Calcote, V. R. and D. E. Hyder. 1981. Pecan Weevil Preference for Various Pecan Cultivars. J. Econ. Entomol. 14:223-226.

Weslaco, Texas

Myerdirk, D. E., French, J. V., Chandler, L. D. and Hart, W. G. 1981. Effects of Commercially Applied Pesticides for Control of the Citrus Mealybug. Southwest. Entomol. 6:49-52.

Wharton, R. A., Gilstrap, F. E., Rhode, R. H., Fishel, M., and Hart, W. G. 1981. Hymenopterous egg-pupal and larvel-pupal parasitoid of Ceratitis capitata and Anastrepha spp. in Costa Rica. Entomophaga 26:285-290.

Yakima, Washington

Annis, B., G. Tamaki, and R. E. Berry. 1981. Seasonal Occurrence of Wild Secondary Host of the Green Peach Aphid, Myzus persicae (Sulzer), in Agricultural Systems in the Yakima Valley. Environ. Entomol. 10:307-312.

Burditt, A. K., Jr., and R. A. Baranowski. 1981. Management of Arthropod Pest for Subtropical Fruits. In: Tree Fruit and Nut Management in the Southeastern United States, D. T. Johnson, ed., Ent. Soc. Amer. Misc. Pub. 12(2):85-0-90.

Burditt, A. K., Jr., M. G. Moshonas, T. T. Hatton, D. H. Spalding, D. L. von Windeguth, and P. E. Shaw. 1981. Low-Dose Irradiation as a Treatment for Grapefruit and Mangoes Infested with Caribbean Fruit Fly Larvae. USDA-ARS-S-9pp.

Fields, G. J., R. W. Zwick , and H. R. Moffitt. 1981. A Bibliography of Psylla (Homoptera: Psylidae) on Pear Trees. USDA, BLA 17, 23 pp.

Fye, R. E. 1981. An Analysis of Pear Psylla Population 1977-79. USDA SEA ARS-W-24. 32 pp.

Fye, R. E. 1981. A Method for Rearing Pear Psyla. J. Econ. Entomol. 74:490-491.

Fye, R. E. 1981. Rearing and Release of Coccinellids for Potential Control of Pear Psylla. USDA ARS ATT-W-20. 9 pp.

Fye, R. E. 1981. Pear, Codling Moth Control. 1980 Insecticide and Acarcide Tests 6:29-30.

Fye, R. E., V. R. Reddy, and D. N. Baker. 1981. Cotton Plants: A Preliminary GOSSYM Model. USDA ARS AAT-W-18. 36 pp.

Halfhill, J. E. 1981. Cabbage maggot control on Chinese cabbage, Japanese radish, and turnip. Insecticide and Acaricide Tests 6:54.

Hathaway, D. O. 1981. Peach Twig Borer: Field Evaluation of Concentrations of Pheromone and Monitoring of Populations. J. Econ. Entomol. 74:344-345.

Howell, J. F. 1981. Codling Moth: The effect of adult diet on longevity, fecundity, fertility, and mating. J. Econ. Entomol. 74:13-18.

Howell, J. F. 1981. Codling Moth: Blacklight Trapping and Comparisons with Fermenting Molasses Bait and Pheromone Traps. USDA, ARS-W-22. 14 p.

Howell, J. F. 1981. Codling Moth: The effects of volcanic ash from the eruption of Mount St. Helens on Egg, Larval, and Adult Survival. Melanderia 37:50-55.

Powell, D. M. 1981. Control of the Green Peach Aphid on Potatoes with Soil Systemic Insecticides: Preplant Broadcast and at-planting Time Furrow Applications from 1973-1977. J. Econ. Entomol. 839-843.

Powell, D. M. 1981. Systemic Insecticides for Control of the Green Peach Aphid and the Potato Beetle on Potatoes. Wash. State Potato Conference Proceedings. 20:21-24.

Powell, D. M. 1981. Potato Insects: In P. H. Schwartz and D. H. Hamel, (ed), Guidelines for Control of Insect and Mite Pests of Foods, Fibers, Feeds, Ornamentals, Livestock, Households, Forests, and Forest Products. USDA Handbook 571. Revised June, 1981.

Tamaki, G. 1981. Exploiting the ecological interaction of the green peach aphid on peach trees. U.S. Dept. Agric. Tech. Bull. 1640, 6 pp.

Tamaki, G., B. Annis, and M. Weiss. 1981. Response of Natural Enemies to the Green Peach Aphid in Different Plant Cultures. Environ. Entomol. 10:375-378.

Toba, H. H. 1981. Seed Piece Examination: A Method for Sampling Wireworms on Potatoes. Proc. 20th Annual Wash. St. Potato Conf. and Trade Fair, p. 15-20.

Toba, H. H. and J. E. Turner. 1981. Potato, Wireworm Control, Hermiston, Oregon, 1979. Insecticide and Acaricide Tests 6:92-93.

Toba, H. H. and J. E. Turner. 1981. Potato, wireworm control, Pasco, Washington, 1979. Insecticide and Acaricide Tests 6:93-94.

Toba, H. H. and J. E. Turner. 1981. Comparison of four methods of applying insecticides for control of wireworms on potatoes. J. Econ. Entomol. 74:254-255.

Toba, H. H., J. E. Turner, and D. M. Powell. 1981. Relationship between injury and damage to potatoes by wireworms. Am. Potato J. 58:(8):423-428.

Kearneysville, West Virginia

Butt, B. A. 1981. The biologic and economic assessment of Amitraz. Cooperative Impact Assessment Report. USDA, Tech. Bull. 1637, 82 pp.

Butt, B. A. 1981. The Appalachian Fruit Research Station. Virginia State Hort. Soc. Proc. 69:3:52-55.

Jermy, T., B. A. Butt, L. M. McDonough, D. L. Dreyer, and A. F. Rose. 1981. Antifeedants for the Colorado Potato Beetle--Antifeeding Constitutents of Some Plants from the Sagebrush Community. Insect Sci. Application 1:3:237-242.

PRINCIPAL CONTACTS - NRP 20220

Riverside, California -	Dr. Dale E. Meyerdirk, RL USDA, SEA, ARS P. O. Box 112 University of California Riverside, CA 92502 Tel: 714-787-5722 FTS: 796-1592
Miami, Florida -	Dr. Peter J. Landolt USDA, SEA, ARS 13601 Old Cutler Road Miami, FL 33158 Tel.: 305-238-9321 FTS: 350-5820
Orlando, Florida -	Mr. Allen G. Selhime, RL USDA, SEA, ARS 2120 Camden Road Orlando, FL 32803 Tel: 305-898-6791
Byron, Georgia -	Dr. J. Wendell Snow, LD USDA, SEA, ARS P. O. Box 87 Byron, GA 31008 Tel.: 912-956-5656 FTS: 238-0421
Honolulu, Hawaii -	Dr. Leroy Williamson, LD USDA, SEA, ARS P. O. Box 2280 Honolulu, HI 96804 Tel.: 808-988-2158 FTS: 556-0220 Opr.
Kimberly, Idaho -	Dr. Carl C. Blickenstaff, RL USDA, SEA, ARS Route 1, Box 186 Kimberly, ID 83341 Tel.: 208-423-5582 FTS: 554-6578
Vincennes, Indiana -	Dr. David K. Reed, RL USDA, SEA, ARS P. O. Box 944 Vincennes, IN 47591 Tel: 812-882-4942

West Lafayette, Indiana -

Dr. Hilary F. Goonewardene
USDA, SEA, ARS
Department of Entomology
Purdue University
West Lafayette, IN 47907
Tel.: 317-494-8230

Beltsville, Maryland -

Dr. William W. Cantelo
Vegetable Insects
Dr. John W. Neal
Florist and Nursery Crops
USDA, SEA, ARS
Bldg. 470, BARC-East
Beltsville, MD 20705
Tel.: 301-344-2269
FTS: 344-2269

Wooster, Ohio -

Dr. T. L. Ladd, RL
USDA, SEA, ARS
Ohio Agricultural Research
and Development Center
Japanese Beetle and Horticultural
Insect Pests Research Laboratory
Wooster, OH 44691
Tel.: 216-264-1021 x147

Corvallis, Oregon -

Dr. Robert G. Linderman, RL
USDA, SEA, ARS
Ornamental Plants Research Lab.
3420 Southwest Orchard Street
Corvallis, OR 97330
Tel.: 503-757-4544

Charleston, South Carolina -

Dr. James M. Schalk, RL
USDA, SEA, ARS
Vegetable Laboratory
2875 Savannah Highway
Charleston, SC 29407
Tel.: 893-556-2210

Brownwood, Texas -

Mr. Vernon R. Calcote
USDA, SEA, ARS
P. O. Box 579
Brownwood, TX 76801
Tel.: 915-646-0593

Weslaco, Texas -

Mr. William G. Hart, RL
USDA, SEA, ARS
P. O. Box 267
Weslaco, TX 78596
Tel.: 512-968-3159

Yakima, Washington -	Dr. Arthur K. Burditt, LD USDA, SEA, ARS 3706 W. Nob Hill Blvd. Yakima, WA 98902 Tel.: 509-575-5877 FTS: 446-5877
Kearneysville, West Virginia -	Mr. Billy A. Butt, LD USDA, SEA, ARS Appalachian Fruit Research Station Rt. 2, Box 45 Kearneysville, WV 25430 Tel.: 304-725-3451

National Research Program 20230

COTTON AND TOBACCO INSECTS

This National Research Program involves research that will result directly or indirectly in the development of new and improved practices for controlling insects attacking cotton and tobacco. Research is conducted within five major thrust areas: (1) develop fundamental knowledge of the biology and ecology of insect and mite pests, (2) develop principles of host-plant resistance, other host-pest interactions and cultural approaches needed to reduce losses caused by insect and mite pests, (3) develop principles of biological control needed to reduce losses caused by insect and mite pests, (4) develop principles of chemical methods, including insect growth regulators and behavioral chemicals, needed to reduce losses caused by insect and mite pests, and (5) develop principles for integrating methods into systems and systems into strategies appropriate for reducing losses caused by insect and mite pests on crops grown in cotton and tobacco agroecosystems. Resources are allocated to deal primarily with problems of national or regional importance and to conduct innovative high priority research unlikely to be adequately addressed by the private sector.

Technological Objective 1: New and improved ecologically acceptable methods for reduction of losses caused by insects and mites attacking cotton.

NPS Contact: R. L. Ridgway

Research Locations:

Phoenix, Arizona
Tucson, Arizona
Brawley, California
Mississippi State, Mississippi
Stoneville, Mississippi
Raleigh, North Carolina
Florence, South Carolina
Brownsville, Texas
College Stations, Texas
St. Croix, Virgin Islands

Examples of Recent Progress:

Boll weevil populations in cultivated cotton in Arizona and Mexico are from same population - Phoenix, Arizona. Genetic distances, based on allozyme frequencies, between boll weevils from cultivated cotton in Arizona and in Sonora, Mexico averaged less than 0.080, indicating that these weevils were from the same population. Genetic distances calculated between these weevils, and between weevils from Thurberia plants averaged 0.288, indicating that the weevils from cultivated cotton and from Thurberia plants are different populations.

Resistance in cotton to seed damage by pink bollworm has simple inheritance - Phoenix, Arizona. Resistance to seed damage by the pink bollworm is conditioned by perhaps as few as two pairs of genes that act additively. Therefore, the transfer of this character from the breeding stock AET-5 to superior agronomic types of cotton should be relatively easy.

Nondiapausing strain shows promise for control of pink bollworm in laboratory test - Phoenix, Arizona. A 3 to 1 ratio of a strain of pink bollworms selected for its nondiapausing character and a normal unselected strain produced an F_1 generation in which 72 percent of the progeny did not enter diapause.

Either of the two isomers in the pink bollworm pheromone, gossyplure, will disrupt communication - Phoenix, Arizona. Results of studies in a wind tunnel and in the field indicated that adult pink bollworms do not respond to the pheromone if the ratio of isomers is changed markedly from the normal 1 to 1. This finding indicates it may be more efficient to use one than two isomers in a control program.

Attracticide shows promise for control of pink bollworm adults - Phoenix, Arizona. A sprayable formulation containing a commercial adjuvant, the pink bollworm pheromone, and pyrethroid insecticides produced over 90 percent mortality of pink bollworm adults. The sprayed material attracted and killed males for at least 7 days.

Rearing system for lygus bugs improved - Tucson, Arizona. Production of lygus bugs on artificial diet was increased 7-fold over previous years with a maximum of 24,000 per week produced. Rearing costs were reduced from $19.94 per 1000, when green beans were used as food, to $2.82 per 1000. This increased efficiency in production of these pests will enable reliable and economical production of their parasites for research on augmentative releases for suppression of lygus bug populations.

An egg parasite, reared on lygus bugs from rearing system - Tucson, Arizona. A large culture of the egg parasite, Anaphes ovijentatus, was reared on lygus bug eggs deposited in ovipositional packets from the lygus bug rearing system. This technique will enable moderate-scale research on the use of augmentative releases of A. ovijentatus to suppress lygus bug populations.

Parasitism of lygus bug numphs reached high levels at Yuma, Arizona - Tucson, Arizona. Up to 60-70 percent of the nymphs collected from block-cut and alfalfa seed fields were parasitized by Leiophron uniformis. This is the highest level of parasitism by this species recorded in Arizona. These results indicate the parasite has more potential for lygus bugs suppression than previously thought and is a candidate for augmentative release programs.

Effective cultural control of the pink bollworm requires that cotton fruiting be terminated by September 1 - Brawley, California. Precise crop management is required in order to obtain maximum yields and prevent accumulation of diapausing pink bollworms. Application of the chemical terminators, dicamba and chlorflurenol, decreased boll retention by 50 to 75 percent but interfered with normal defoliation.

Evaluation of alternative cotton insect programs suggests expansion of area-wide programs - Beltsville, Maryland. A USDA Task Force on Boll Weevil/Cotton Insect Management reviewed a series of evaluation reports on cotton insect programs and developed recommendations to the Secretary of Agriculture. Based on actual and potential benefits, the task force recommended and the Secretary concurred, that USDA should "facilitate testing and expansion of area-wide cotton insect management trials and programs throughout the Cottonbelt, including possible future expansion of boll weevil eradication in the southeastern United States."

Fat body in boll weevil tentatively identified as the site of pheromone production - Mississippi State, Mississippi. The definition of the site of synthesis for the pheromone in the fat bodies of the boll weevil constitutes a basic step in the scientific knowledge of the complex mechanism of communication between insects of the same species. This knowledge can be extended to develop control of the synthesis through genetical or biochemical means that should result in a weevil with the capacity for a high production level of pheromone that would yield a more competitive adult insect.

Biochemical analyses useful in characterizing diseased cotton bollworms - Mississippi State, Mississippi. Bollworms injected with an iridescent virus had lower levels of fatty acids and of glycogen than normal bollworms; however, total protein did not differ significantly.

Increased concentrations of anthocyanin associated with increased resistance to the tobacco budworm - Mississippi State, Mississippi. Evaluation of a large number of lines over a three-year period indicated that gossypol and anthocyanins were negatively correlated with feeding of tobacco budworm larvae and tannins were uncorrelated, even though all three groups of chemicals are toxic if incorporated into laboratory diets.

Improved method for sterilizing boll weevils developed - Mississippi State, Mississippi. The use of either of two synthetic ecdysteroids instead of diflubenzuron for sterilizing female boll weevils following acute irrigation of males and females results in sterile insects that were more competitive than diflubenzuron-fed irradiated males.

Sterile boll weevils effective in suppressing boll weevils in field tests - Mississippi State, Mississippi. Six releases of diflubenzuron-fed irriadiated boll weevils at 5-day intervals reduced egg hatch by over 80 percent and reduced the population growth 75 percent in isolated field tests in Arkansas.

A six component pheromone mixture effective in disrupting communication in populations of cotton bollworms - Stoneville, Mississippi. Application of a six component mixture to 10 acre plots at weekly intervals reduced trap capture of bollworm moths by 46.5% and of tobacco budworm moths by 6.2%.

Dispersal of released weevils indicates movement in excess of 60 miles - Raleigh, North Carolina. Boll weevils were captured, marked with paint, and then released in an area containing 3,000 boll weevil sex pheromone traps located 3 miles apart. Of the 48,000 weevils marked and released, 46 were recaptured. Six were recaptured 21-40 miles from the release point and 2 were more than 60 miles from the release point.

Quantitative data on role of predators in regulating bollworm populations obtained - Raleigh, North Carolina. Predator insects and spiders consumed up to 1.2% per hour of the bollworm eggs and up to 11.2% per hour of the bollworm larvae present in a cotton field. Correlation of these values with numbers of naturally occurring predators will improve the capability to predict when injurious populations of bollworms will develop from a given number of eggs or small larvae.

Pheromone traps placed around fields will detect the progeny of a single pair of boll weevils in the F_1 or F_2 generation - Raleigh, North Carolina. Boll weevils were captured in pheromone traps located around cotton fields 23-41 days after a single pair of fertile weevils was released in each of 12 fields. Weevil-damaged fruit was not detected during the 48 day test. Therefore, pheromone traps are more efficient than inspection of cotton fruit for detection of low boll weevil populations.

Insecticide use drastically reduced by eradication of the boll weevil - Raleigh, North Carolina. Results from monitoring insecticide use in sample fields in the boll weevil eradication zone in northern North Carolina and from areas outside the eradication area indicate that the number of insecticide applications have been reduced by over 70% on over 40,000 acres of cotton by boll weevil eradication and improved management of the bollworm and tobacco budworm. Over 10 applications were used in 1978 before eradication and less than 3 applications were used in 1981 after eradication.

A new experimental breeding line, Pee Dee 4548, was released, registered, and distributed to bona fide geneticists and breeders for use in their cotton improvement programs - Florence, South Carolina. Pee Dee 4548 continued to exhibit high yield potential, exceptionally high fiber strength for medium staple cotton, unusually high lint percentage, and wide adaptation in the 1980 and 1981 Official South Carolina Variety Test and the 1981 Eastern Regional Variety Test.

Number of bollworms and tobacco budworms emerging from soil in the spring affected by the tillage practices - Florence, South Carolina. The number of bollworm moths and tobacco budworm moths emerging from 3 tillage treatments (undisturbed, double-disked, subsoiled and bedded) was found to be significantly higher (4.4 and 2.8X) in the undisturbed soil. The results suggest that some cultivation is desirable to reduce the number of overwintered moths in minimum tillage systems.

The amount of triglycerides found to be a major factor in resistance of weevils to fat-soluble insecticides - Florence, South Carolina. A linear relationship between the LD_{50} of the boll weevil to toxaphene-DDT was shown. Diets that produced in weevils an increased tolerance to toxaphene-DDT also produced in weevils an increased tolerance to permethrin.

The lethal effect of pyrethroids against the boll weevil is due primarily to contact with spray droplets - Florence, South Carolina. Mortality, at 48 h, of weevils sprayed with pyrethroids was compared with that of weevils caged on the plant 1 h after spraying. Mortality rates were $\leq$65% from contact with spray droplets but $\leq$63% on the plant 1 h after application. These dates suggest that pyrethroids should be applied at not less than 3- to 5-day intervels for boll

weevil control, which is more frequent than is needed for bollworm control. Producers might want to use more economical organophosphate insecticides for weevil control.

Spring populations of tobacco budworms in the Rio Grande Valley are derived from populations common to the area - Brownsville, Texas. Pheromone trap captures of tobacco budworm moths corresponded with emergence of the insects from diapause. Studies of larval populations on early season wild hosts also confirmed that the age structure of the populations was compatible with the emergence of adults from diapause in the area.

Experimental breeding lines of cotton reduces boll weevil emergence - Brownsville, Texas. The experimental cotton lines, HG-DDS-N-1, ARKUGO X HGT 216, and G-1-1-144, significantly reduced boll weevil adult emergence and lines 116-DDS-N-1 and HG-1 prevented emergence from squares. Adult emergence and longevity of boll weevils developing in bolls were also reduced.

The insect growth regulator, penfluron, reduced boll weevils - Brownsville, Texas. Reduction of boll weevil emergence from squares was substantially greater than in bolls. The addition of oil increased efficiency.

Four species of the egg parasites found attacking cotton bollworms and tobacco budworms in central Texas - College Station, Texas. Trichogramma exiguum, T. pretiosum, T. minutum, and T. maltbyi, were identified among males that emerged from Heliothis spp. eggs collected from corn, cotton, grain sorghum, and pigeon peas; however, ca. 98% of the males identified were either T. exiguum or T. pretiosum. The predominant species among males emerging from eggs collected from corn from early May to late June was T. exiguum whereas the predominant species emerging from eggs collected from cotton from mid-July to late September was T. pretiosum.

Artificial diet developed for a parasitic fly that attacks the bollworm and tobacco budworm - College Station, Texas. An artificial diet used for in vitro rearing of the tachinid parasite Eucelatoria bryani provided yields of large fecund adults, as high as 55%. Recent deletions of unnecessary components, and the use of soy protein and lactalbumin hydrolysate as the sources of most of the amino nitrogen in the diet, will lead to sizable savings in costs in a large-scale production program. These encouraging results in research on diets and in vitro production methods suggest that there is a good probability of successfully mass-producing E. bryani for use in an augmentation program.

Pheromone trap captures and computer models to predict emergence from diapause used to measure bollworm migration - College Station, Texas. Concurrent observations of emergence of local overwintered bollworm adults from soil and the response of wild males to pheromone baited traps indicated that significant numbers of insects were captured beginning at least 4 weeks in advance of local emergence. The asynchrony of these events suggests that bollworms trapped before the emergence of local overwintered insects were immigrants. Studies of meteorological records during that period indicate that high level wind patterns were favorable for the long range transport of insects from south to north.

Technological Objective 2: New and improved methods to improve safety of tobacco through improved insect control.

NPS Contact: R. L. Ridgway

Research Locations:
Oxford, North Carolina

Example of Recent Progress:

Practical insect management program on tobacco demonstrated - Oxford, North Carolina. A four-year pilot test completed in 1980 demonstrated that selective control of tobacco budworms and hornworms with the microbial agent, Bacillus thuringiensis, following careful field surveys provides an effective and economical control program in about 90% of the tobacco fields. A selective insecticide for control of green peach aphids was needed on about 10% of the fields.

These results suggest that the early season colonization of bollworms in this country may be attributable in part to their migration from tropical regions.

A pheromone specific for Heliothis subflexa confirmed in field tests - College Station, Texas and Beltsville, Maryland. Pheromone traps baited with a preparation developed at Beltsville, MD, captured more males than traps baited with 3 virgin females.

Tobacco budworm eggs and larvae reduced by 75 percent by the release of sterile backcross insects - St. Croix, Virgin Islands. The release of about 45,000 sterile backcross insects per day from August 17 to December 17, 1980 resulted in about 75% reduction in egg and larval collections of tobacco budworms on pigeon pea and Bastardia plants. Also, the rate of increase of tobacco budworms in the spring of 1981 was only 2-fold compared with increases of 19- and 10-fold during 1979 and 1980.

PUBLICATIONS

Phoenix, Arizona

Bariola, L. A., T. J. Henneberry, and D. L. Kittock. 1981. Chemical termination and irrigation cutoff to reduce overwintering populations of pink bollworms. J. Econ. Entomol. 74:106-109.

Bartlett, A. C. 1981. Isozyme polymorphism in populations of the pink bollworm. Ann. Entomol. Soc. Am. 74:9-13.

Bartlett, A. C. 1981. Isozyme polymorphisms in boll weevils and Thurberia weevils from Arizona. Ann. Entomol. Soc. Am. 74:359-362.

Bergman, D., L. A. Bariola, and T. J. Henneberry. 1981. Boll weevil infestations in Arizona cultivated Cotton. Proc. Beltwide Cotton Prod. Res. Conf., pp. 70-72.

Bergman, D., T. J. Henneberry, and L. A. Bariola. 1981. Overwintering and seasonal development of the pink bollworm in Arizona stub and planted cotton. Proc. Beltwide Cotton Prod. Res. Conf., pp. 66-69.

Butler, G. D., Jr. 1981. Biological control of weeds in Arizona. Weeds Today 12(3):18-19.

Butler, G. D., Jr., and J. D. Lopez. 1981. Trichogramma praetiosum: Development in two hosts in relation to constant and fluctuating temperatures. Ann. Entomol. Soc. Am. 73:671-673.

Flint, H. M., and J. R. Merkle. 1981 Early-season movements of pink bollworm male moths between selected habitats. J. Econ. Entomol. 74:366-71.

Flint, H. M., J. R. Merkle, and M. Sledge. 1981. Attraction of male Collops vittatus in the field by caryophyllene alcohol. Environ. Entomol. 10:301-304.

George, B. W., and F. D. Wilson. 1981 Selecting cottons with artificial infestations of pink bollworm. Proc. Beltwide Cotton Prod. Res. Conf., p. 63.

Henneberry T. 1981. Future thrusts on mating disruption of pest insects with semiochemicals. pp. 399-401. In Everett R. Mitchell (ed.) Management of Insect Pests with Semiochemicals, Plenum Press, New York. 513 pp.

Henneberry, T. J., L. A. Bariola, H. M. Flint, P. D. Lingren, J. M. Gillespie, and A. F. Kydonieus. 1981. Pink bollworm and tobacco budworm mating disruption studies on cotton. pp. 267-283. In Everett R. Mitchell (ed.) Management of Insect Pests with Semiochemicals, Plenum Press, New York. 513 pp.

Henneberry T. J., and T. Clayton. 1981. Effects on reproduction of gamma irradiated, laboratory-reared pink bollworms and their F_1 progeny after matings with untreated laboratory-reared or native insects. J. Econ. Entomol. 74:19-23.

Henneberry, T. J., T. Clayton, and D. F. Keaveny. 1981. Effects of gamma radiation on mating, reproduction and longevity of laboratory-reared or native St. Croix strain. Southwest Entomol. 5:250-256.

Henneberry, T. J., J. M. Gillespie, L. A. Bariola, H. M. Flint, P. D. Lingren, and A. F. Kydonieus. 1981. Gossyplure in laminated plastic formulations for mating disruption and pink bollworm control. J. Econ. Entomol. 74:376-381.

Kittock, D. L., T. J. Henneberry, and L. A. Bariola. 1981. Fruiting of upland and Pima cotton with different planting dates. Agron. Journal 73:711-715.

Kittock, D. L., T. J. Henneberry, L. A. Bariola, and V. T. Walhood. 1981. Water use efficiency of Upland and Pima cottons under short and long season production. Proc. Beltwide Cotton Prod. Res. Conf., pp. 106-110.

Lingren, P. D., J. Burton, W. Shelton, and J. R. Raulston. 1981 Night vision goggles: for design, evaluation and comparative efficiency determination of a pheromone trap for capturing live adult male pink bollworms. J. Econ. Entomol. 73:622-630.

Martin, P. B., P. D. Lingren, G. L. Greene, and A. H. Baumhover. 1981. Seasonal occurrence of Rachiplusia ou, Autographa biloba, and associated entomophages in clover. J. Georgia Entomol. Soc. 16:288-295.

Merkle, J. M., and H. M. Flint. 1981. Responses of male pink bollworms to various mixtures of Z,Z- and Z,E- isomers of gossyplure in gossyplure-treated fields. Southwest Entomol. 6:114-116.

Ridgway, R. L., F. I. Proshold, T. J. Henneberry, D. F. Martin, and D. Keaveny. 1981. St. Croix studies with sterile pink bollworms and backcross tobacco budworms. Proc. Beltwide Cotton Prod. Res. Conf. pp. 152-153.

Sharpe, P. J. H., R. M. Schoolfield, and G. D. Butler, Jr. 1981. Distribution model of Heliothis zea (Lepidoptera: Noctuidae) development time. Canadian Entomol. 113:845-856.

Walhood, V. T., T. J. Henneberry, L. A. Bariola, D. L. Kittock, and C. M. Brown. 1981. Effect of short-season cotton on overwintering pink bollworm larvae and spring moth emergence. J. Econ. Entomol. 74:297-302.

Waller, G. D., F. D. Wilson, and J. H. Martin. 1981. Influence of cotton genotype, season and time-of-day on nectar production. Crop Sci. 21:507-511.

Wilson, F. D., and B. W. George. 1981. Breeding cotton for resistance to pink bollworm. Proc. Beltwide Cotton Prod Conf., pp. 63-65.

Wilson, F. D., and B. W. George. 1981. Breeding potential of noncultivated cottons. V. Productivity of cultivars, race stocks, and F_1 hybrids among them in long-and short-day environments. Crop Sci. 21-410-414.

Wilson, F. D., and B. W. George. 1981 Effect of pink bollworm on yield components in cotton. Agron. Abstr. p. 76.

Wilson, F. D., and B. W. George 1981. Lint yield and resistance to pink bollworm in early maturing cotton. Crop Sci. 21:213-216.

Wilson, F. D., B. W. George, and R. L. Wilson. 1981. Screening cotton for resistance to pink bollworm. USDA-SEA-ARM-W-22. p. 22.

Wilson, F. D., R. L. Wilson, and B. W. George. 1981. Agronomic and fiber properties of primitive race stocks and hybrids of cotton. USDA-SEA-ARM-W-21. p. 32.

Tucson, Arizona

Debolt, J. W. 1981. Laboratory biology and rearing of Leiophron uniforms (Gahan) (Hymenoptera: Braconidae), a parasite of Lygus spp. (Hemiptera: Miridae). Ann. Entomol. Soc. Am. 74:334-337.

Beltsville, Maryland

Ables, J. R., and R. L. Ridgway. 1981. Augmentation of entomophagous arthropods to control pest insects and mites. pp. 273-303. In Papavizas, G. C. (ed.). Proc. BARC Symposium 5, Beltsville, MD. Biological Control in Crop Production. Allenhead Osmun and Co., New Jersey.

Ridgway, R. L., J. R. Ables, C. Goodpasture, and A. W. Hartstack. 1981. Trichogramma and its utilization for crop protection in the U.S.A. In Proc. Joint Amer.-Soviet Conf. on Use of Beneficial Organisms in the Control of Crop Pests. pp. 41-48. ESA, College Park, MD.

Ridgway, R. L., F. I. Proshold, T. J. Henneberry, D. F. Martin, and D. Keaveny. 1981. St. Croix studies with sterile pink bollworms and backcross tobacco budworms. In Proc. Beltwide Cotton Prod. Res. Conf. pp. 152-153.

Mississippi State, Mississippi

Dickerson, W. A., G. H. McKibben, E. P. Lloyd, J. F. Kearney, J. J. Lam, Jr., and W. H. Cross. 1981. Field evaluation of a modified in-field boll weevil trap. J. Econ. Entomol. 74(3):280-282.

Haynes, J. W. 1981. Effects of soil temperatures and chilling on flight and mortality of sterile boll weevils. J. Ga. Entomol. Soc. 16:254-257.

Haynes, J. W., W. L. McGovern, and J. E. Wright. 1981. Diflubenzuron (solvent-water suspension) dip for boll weevils: effects measured by flight, sterility, and sperm transfer. Environ. Entomol. 10:492-495.

Haynes, J. W., and J. E. Wright. 1981. Diflubenzuron feeding plus X-irradition of boll weevils: effects of dose rate on sterility and survival. J. Ga. Entomol. Soc. 16:376-385.

Haynes, J. W., J. E. Wright, and E. Mattix. 1981. A diflubenzuron dust method of sterilizing female boll weevils. MAFES Res. Rep. Vol. 6, No. 4, p. 4.

Hedin, P. A., D. H. Collum, W. H. White, W. L. Parrott, H. C. Lane, and J. N. Jenkins 1981. The chemical basis for resistance in cotton to Heliothis insects. Proc. Int. Conf. on Regulation of Insect Development and Behavior, Karpacz, Poland, Wroclaw Univ. Press pp. 1171-1186.

Lindig, O. H., P. A. Hedin, and W. E. Poe. 1981. Amino acids in pecan weevil, southwestern corn borer and tarnished plant bug and at their feeding sites. Comp. Biochem. Physiol. 68A:261-263.

Mitchell, E. B., M. E. Merkl, J. E. Wright, T. B. Davich, and R. F. Heiser. 1981. Sterility of boll weevils in the field following treatment with diflubenzuron and gamma irradiation. J. Econ. Entomol. 74(6):824-826.

Pfrimmer, T. R., and M. E. Merkl. 1981. Boll weevil: Winter survival in surface woods trash in Mississippi. Environ. Entomol. 10(3):419-423.

Thompson, A. C., and F. M. Davis. 1981. The effect of temperature on the rate of metabolism of lipids and glycogen in diapausing southwestern corn borers. Comp. Biochem. Physiol. 70:555-558.

Thompson, A. C., and P. P. Sikorowski. 1981. Energy difference in lipid and glycogen metabolism of healthy and iridescent virus-infected Heliothis zea. Comp. Biochem. Physiol. 70:179-183.

Wiygul, G., and P. P. Sikorowski. 1981. Oxygen uptake in larval bollworms (Heliothis zea) infected with the fungus Nomuraea riley. Comp. Biochem. Physiol. 68A:103-106.

Wright, J. E., and B. R. Thomas. 1981. Determination of the components of the boll weevil pheromone with a pressure liquid chromatographic method. J. Liq. Chromatog. 4(8):1409-1416.

Stoneville, Mississippi

Bell, James, V., E. G. King, and R. J. Hamalle. 1981. Some microbial contaminants and control agents in a diet and larvae of Heliothis spp. J. Invertebr. Pathol. 37:243-248.

Cleveland, T. C. 1981. Boll weevil: a parasitic nematode of the boll weevil. J. Ga. Entomol. Soc. 16:122-125.

Cleveland, T. C., B. W. Hanny, and Joe Riley. 1981. Tobacco budworm: Effect of larval feeding on presquaring cotton. Environ. Entomol. 10:372-374.

Pfrimmer, T. R. 1981. Heliothis spp.: Insecticidal control on cotton at Stoneville, MS, in 1978. J. Ga. Entomol. Soc. 16:41-47.

Pfrimmer, T. R., and M. E. Merkl. 1981. Boll weevil: winter survival in surface woods trash in Mississippi. Environ. Entomol. 10:419-423.

Pfrimmer, T. R., E. A. Stadelbacher, and M. L. Laster. 1981. Heliothis spp.: Seasonal incidence on cotton in the Mississippi Delta. Environ. Entomol. 10:642-644.

Scott, W. P., J. W. Smith, and C. R. Parencia. 1981. Insecticide use in Panola and Pontotoc Counties, Mississippi, 1977-1980, during the Optimum Pest Management Trial. Bulletin ESA, December 1981.

Stadelbacher, E. A. 1981. Role of early-season wild and naturalized host plants in the buildingup of the F_1 generation of Heliothis virescens and H. zea in the Delta of Mississippi. Environ. Entomol. 10:766-770.

Stadelbacher, E. A., and D. F. Martin. 1981. Fall diapause and spring emergence of Heliothis virescens, H. subflexa, and the backcross of their hybrid. Environ. Entomol. 10:139-142.

Stadelbacher, E. A., and D. F. Martin. 1981. Fall diapause, winter mortality and spring emergency of the tobacco budworm in the Delta of Mississippi. Environ. Entomol. 10:533-556.

Oxford, North Carolina

Lam, Jr., J. J., K. D. Elsey, and A. H. Baumhover. 1981. Collection and storage of an insect predator, Jalysus spinosus. Eviron. Entomol. 10:158-60.

Raleigh, North Carolina

Dickerson, W. A., G. H. McKibben, E. P. Lloyd, J. F. Kearney, J. J. Lam, and W. H. Cross. 1981. Field evaluation of a modified in-field boll weevil trip. J. Econ. Entomol. 74:280-282.

Lloyd, E. P., E. F. Knipling, G. H. McKibben, J. A. Witz, A. W. Hartstack, J. E Leggett, and D. F. Lockwood. 1981. Mass trapping for detection, suppression, and integration with other suppression measures against the boll weevil. pp. 191-203. In Everett R. Mitchell (ed.) Management of Insect Pests with Semiochemicals. Plenum Press, New York.

Florence, South Carolina

Culp, T. W. 1981. Lint yield and fiber quality improvements in PD Lines of upland cotton. S. C. Agric. Exp. Stn. Tech. Bull. 1081.

Culp, T. W. 1981. Registration of Pee Dee 4548 germplasm line of cotton. Crop Sci. 21:992.

Culp, T. W. 1981. Performance of cotton hybrids with extra fiber strength. Agron. Abstr. p. 59.

Hopkins, A. R., J. A. Onsager, R. F. Moore, and W. James. 1981. Comparison of spatial distribution of Heliothis spp. larvae and injured squares in cotton as estimated by three sampling methods. J. Econ. Entomol. 74:409-420.

Lloyd, E. P., E. F. Knipling, G. H. McGibbens, J. A. Witz, D. F. Lockwood, E. F. Knipling, and J. E. Leggett. 1981. Mass trapping for detection, suppression, and integration with other suppression measures against the boll weevil. pp. 191-203. In Everett R. Mitchell (ed.) Management of Insect Pests with Semiochemicals. Plenum Press, New York.

Roach, S. H. 1981. Emergence of overwinter Heliothis spp. moths from three different tillage systems. Environ. Entomol. 10:817-818.

Roach, S. H. 1981. Reduced vs. conventional tillage practices in cotton and tobacco: a comparison of insect population and yields in NE South Carolina in 1977-79. J. Econ. Entomol. 74:688-695.

Roach, S. H., and A. R. Hopkins. 1981. Reduction in arthropod predator populations in cotton fields treated with insecticides for Heliothis spp. control. J. Econ. Entomol. 74:454-457.

Terranova, A. C. 1981. Polyacrylamide gel electrophoresis of Anthonomus grandis Boheman proteins: profile of a standard boll weevil strain. USDA ARR-S-9.

Brownsville, Texas

Beegle, C. C., H. T. Dulmage, D. A. Wolfenbarger, and E. Martinez. 1981. Persistence of Bacillus thuringiensis activity on cotton foliage. Environ. Entomol. 10:400-401.

Robinson, S. H., D. A. Wolfenbarger, E. Salgado, J. F. Silguero, and R. H. Dilday. 1981. A reevaluation of high bud gossypol in cottons as a deterrent to damage by Heliothis species. Proc. Beltwide Cotton Prod. Res. Conf., pp. 79-80.

Salgado, E., J. F. Silguero, and D. A. Wolfenbarger, D. A. 1981. Resistance of LA 17801 to Heliothis spp. in southern Tamaulipas. Proc. Beltwide Cotton Prod. Res. Conf., p. 80.

Shaver, T. N., D. E. Hendricks, and A. W. Hartstack, Jr. 1981. Dissipation of virelure, a synthetic pheromone of the tobacco budworm, from laminated plastic and cigarette filter dispensers. Southw. Entomol. 6:205-210.

Wolfenbarger, D. A. 1981. Status of resistance to methyl parathion and permethrin in Heliothis spp. Bull. Entomol. Soc. Am. 27:180.

Wolfenbarger, D. A., V. P. R. Bodegas, and G. R. Flores. 1981. Development of resistance in Heliothis spp. in the Americas, Australia, Africa, and Asia. Bull. Entomol. Soc. Am. 27:181-185.

College Station, Texas

Ables, J. R., S. B. Vinson, and J. S. Ellis. 1981. Host discrimination by Chelonus insularis (Hym.: Braconidae), Telenomus heliothis (Hym.: Scelionidae), and Trichogramma pretiosum (Hym.: Trichogrammatidae). Entomophaga 26:149-151.

Ables, J. R., and Ridgway, R. L. 1981. Augmentation of entomophagous arthropods to control pest insects and mites. pp. 273-303. In Papavizas, G. C., (ed.). Proc. BARC Symposium No. 5, Beltsville, Md. Biological Control in Crop Production. Allenhead Osmun & Co., NJ.

Bull, D. L. 1981. Factors that influence tobacco budworm resistance to organophosphorus insecticides. Bull. Entomol. Soc. Am. 27:193-197.

Bull, D. L. 1981. Status of insect growth regulators. Proc. Beltwide Cotton Production Res. Conf., pp. 143-146.

Bull, D. L., and G. W. Ivie. 1981 Fate of O-[4[4-chlorophenyl)thio]phenyl] O-ethyl S-propyl phosphorothioate (RH-0994) in cotton. J. Agric. Food Chem. 29:121-125.

Eger, J. E., Jr., and J. R. Ables. 1981. Parasitism of Pentatomidae by Tachinidae in South Carolina and Texas. Southwest Entomol. 6:28-33.

Ivie, G. W., D. L. Bull, and R. L. Ridlen. 1981. Fate of the insecticide O-[4[(4-chlorophenyl)thio]phenyl] O-ethyl S-propyl phosphorothioate in water. J. Agric. Food Chem. 29:1146-1149.

Lopez, J. D., Jr., T. N. Shaver, and A. W. Hartstack, Jr. 1981. Evaluation of dispensers for the pheromone of Heliothis zea. Southwest. Entomol. 6:117-122.

Morrison, R. K., J. R. Ables, L. F. Bouse, and D. L. Bull. 1981. Status of Trichogramma wasps as a management tool for Heliothis control. Proc. Western Cotton Prod. Conf., Lubbock, Tx. pp. 34-35.

Nettles, W. C. 1981. Effect of water deprivation and subsequent exposure to water on the response of Eucelatoria sp. to okra volatiles and to water vapor. Environ. Entomol 10:111-113.

Ridgway, R. L., C. E. Goodpasture, J. R. Ables, and A. W. Hartstack, Jr. 1981. Trichogramma and its utilization for crop protection in the U.S.A. Proceedings of the Joint American-Soviet Conference on "Use of Beneficial Organisms in the Control of Crop Pests" Washington, D.C. U.S.A. August 13-14, 1979. J. R. Coulson (ed.) Entomol. Soc. Am. p.62.

Shaver, T. M., D. E. Hendricks, and A. W. Hartstack, Jr. 1981. Dissipation of virelure, a pheromone of the tobacco budworm from laminated plastic and cigarette filter dispensers. Southwest. Entomol. 6:205-210.

St. Croix, Virgin Islands

Martin, D. F., F. I. Proshold, and M. L. Laster. 1981. Status of Heliothis hybrid pilot test. Proc. Beltwide Cotton Prod. Res. Conf., pp. 150-151.

Proshold, F. I., and J. L. Gonzales. 1981. Genetic control of an insect pest of pigeon pea. 11th Annual Agriculture and Food Fair of the Virgin Islands. pp. 69-71.

Ridgway, R. L., F. I. Proshold, T. J. Henneberry, D. F. Martin, and D. Keaveny. 1981. St. Croix studies with sterile pink bollworms and backcross tobacco budworms. Proc. Beltwide Cotton Prod. Res. Conf., pp. 152-153.

PRINCIPAL CONTACTS - NRP 20230

Phoenix, Arizona -

Dr. T. J. Henneberry, Lab Director
Western Cotton Research Laboratory
USDA/ARS/WR
4135 East Broadway Road
Phoenix, AZ 85040
Tel.: 602-261-3524
FTS: 261-3524

Dr. L. A. Bariola, Research Leader
Cotton Insects--Pathology & Rearing

Tucson, Arizona -

Dr. H. M. Graham, Research Leader
Biological Control of Insects Unit
Cotton Insect Biocontrol Laboratory
USDA/ARS/WR
2000 East Allen Road
Tucson, AZ 85719
Tel.: 602-327-4482
FTS: 762-6220

Brawley, California -

Dr. C. F. Ehlig, Plant Physiologist
Cotton Insect Mgmt. and Biology Res.
Imperial Valley Conservation Research Ctr
4151 Highway 86
Brawley, CA 92227
Tel.: 714-344-4184
FTS: 556-9000

Mississippi State, Mississippi -

Dr. E. P. Lloyd, Laboratory Director
Boll Weevil Research Laboratory
USDA/ARS/SR
P. O. Box 5367
Mississippi State, MS 39762
Tel.: 601-323-2230
FTS: 490-4676

Dr. P. A. Hedin, Research Leader
Chemistry

Dr. J. Wright, Research Leader
Nutrition, Sterility and Quality Control

Dr. W. H. Cross, Research Leader
Ecology

Stoneville, Mississippi -

Dr. E. G. King, Laboratory Chief
Bioenvironmental Control of Insects
Research Laboratory
U.S. Delta States Agric. Res. Ctr.
USDA/ARS/SR
Stoneville, MS 38776
Tel.: 601-686-2311
FTS: 497-2232

Dr. J. W. Smith, Research Leader
Insect Population Management
FTS: 497-2232

Oxford, North Carolina -

Mr. A. H. Baumhover, Research Leader
Tobacco Insects
Tobacco Research Laboratory
USDA/ARS/SR
Route 2, Box 16G
Oxford, NC 27567
Tel.: 919-693-5151 Ext. 35

Raleigh, North Carolina -

Mr. W. Dickerson
Boll Weevil Eradication Research
USDA/ARS/SR
4120 Reedy Creek Road
Raleigh, NC 27607
Tel.: 919-755-4780
FTS: 672-4780

Florence, South Carolina -

Dr. R. F. Moore, Research Leader
Cotton Research Laboratory
Pee Dee Experiment Station
USDA/ARS/SR
P. O. Box 2131
Florence, SC 29501
Tel.: 803-669-6664
FTS: 677-3321

Brownsville, Texas -

Dr. H. T. Dulmage, Research Leader
Subtropical Crop Protection Laboratory
USDA/ARS/SR
P. O. Box 1033
Brownsville, TX 78520
Tel.: 512-542-2516
FTS: 734-8214/8227

College Station, Texas -

Dr. D. L. Bull, Research Leader
Cotton Insects Research Unit
USDA/ARS/SR
P. O. Drawer DG
College Station, TX 77840
Tel.: 713-846-8821
FTS: 527-1351

St. Croix, Virgin Islands -

Dr. F. I. Proshold, Research Leader
Plant Disease & Insect Population
Control Research
USDA/ARS/SR
Federal Experiment Station
P. O. Box H
Kingshill St. Croix, V.I. 00850
Commercial: 809-778-1312

National Research Program 20240

INSECT CONTROL - GRAINS, FORAGES, SUGAR CROPS, AND OILSEEDS

Technological Objective: Reduce losses in field crops by conducting research to develop new and improved control of insects and mites.

This National Research Program involves research in developing new and improved control methods, tactics, and strategies that may be used singly or combined in integrated systems to reduce pest insect populations and losses to corn, small grains, sorghum, millets, grass and legumes, forages, sugarbeets, sugarcane, soybeans, peanuts, and other field crops.

NPS Contact: Robert D. Jackson

Research Locations:

Tucson, Arizona
Canal Point, Florida
Tifton, Georgia
Kimberly, Idaho
West Lafayette Indiana
Ankeny, Iowa
Manhattan, Kansas
Crowley, Louisiana
Houma, Louisiana
Beltsville, Maryland
East Lansing, Michigan
Mississippi State, Mississippi
Stoneville, Mississippi
Columbia, Missouri
Bozeman, Montana
Lincoln, Nebraska
Fargo, North Dakota
Wooster, Ohio
Stillwater, Oklahoma
Corvallis, Oregon
University Park, Pennsylvania
Brookings, South Dakota
Bushland, Texas
Logan, Utah
Yakima, Washington

Examples of Recent Progress:

Corn:

Radar used to document sources of infestation of corn earworm and fall armyworm - Tifton, Georgia. Radar was used to document heavy flights of these moths rising from heavily infested fields of peanuts and sorghum. These moth flights rose to 400 meters indicating that these fields were sources of infestation beyond the immediate environs of the fields. Thus, heavy infestations in a few fields can have a strong impact upon pest populations over a wide area.

Evidence of a marking pheromone found in larval frass of Heliothis zea - Tifton, Georgia. Field studies in which selected dosages of Heliothis zea larval frass were applied to fresh cornsilk showed that ovipositing females detected the

treated silks and selectively oviposited more eggs on uncontaminated silks. These marking pheromones offer potential for the behavioral management of this economically important insect species.

Insecticides applied in irrigation water allow high yielding second crops of corn and sorghum - Tifton, Georgia. Trials have showed that insecticides applied in irrigation water when 30% of the plants show damage by the fall armyworm provide protection from that pest to a degree which allows production from a second crop of corn planted in July. Yields were 16-18 tons of corn silage or 92 bushels of corn grain per acre. Sorghum yields were 101 bushels of grain per acre. Sweet corn can also be produced with the return of 300+ crates per acre. This protection allows a second crop of corn or sorghum to be planted in July, thus markedly increasing the productivity per acre in the Southeast.

Sublethal doses of irradiation are deleterious to fall armyworm reproduction - Tifton, Georgia. Irradiation of fall armyworms at 6, 8, and 10 KR had a deleterious effect on reproduction by fall armyworm. Fecundity, egg fertility, and rate of survival of larvae, pupae, and adults were less in the irradiated insects than in untreated insects. The reduction in the above parameters persisted throughout at least three generations.

Progress made in developing multiple resistance to pests - Ankeny, Iowa. Progress was continued in the selection for leaf feeding resistance to first generation European corn borers and for resistance to sheath-collar feeding by second generation borers in a synthetic variety of corn. Progress was also made in selecting for resistance to corn borers, stalk rot, and northern corn leaf blight.

Seed treatment useful in controlling black cutworms - Ankeny, Iowa. Insecticide applied to corn seeds reduced black cutworm feeding on corn seedlings. If these results are confirmed in 1982, growers could treat corn seeds for approximately $1/acre as compared to a rescue treatment for black cutworms of $15/acre.

Identity of corn rootworm in Oklahoma and Texas established - Brookings, South Dakota. The true identity of a corn rootworm occurring in Oklahoma and Texas has been established. It resembles the northern corn rootworm (Diabrotica longicornis (Say)), but is actually a subspecies of Diabrotica virgifera Leconte (the western corn rootworm). Studies of sex behavior, genitalia structure, color variation, and biochemical genetics led to recognition of Diabrotica virgifera zea Krysan and Smith, which has been assigned the common name Mexican corn rootworm. Knowledge of the true relationship of this insect to the well known western and northern forms is important because these forms, as pests, have biological differences that are of consequence in the development of pest management strategies.

Laboratory bioassay useful in toxicology studies of corn rootworm - Brookings, South Dakota. Comparative toxicity of soil insecticides used as larvacides for control of corn rootworm was established by using a laboratory soil bioassay. A 15X difference in toxicity from the least toxic insecticide to the most toxic

insecticide was identified. First stage western corn rootworm larvae were generally 3 to 4 times as susceptible as third stage larvae. Also, third stage southern corn rootworm larvae were 2 to 4 times as tolerant to insecticides in this test as third stage western corn rootworm larvae.

Relationship of soil temperatures to corn rootworm survival established - Brookings, South Dakota. The northern corn rootworm is less susceptible to cold winter temperatures than the western corn rootworm. Eggs of the western corn rootworm do not hatch after exposure to 10°C for two weeks; however, northern corn rootworm eggs hatch when they are exposed to the same temperature for up to five weeks. Soil winter temperature studies show that soil temperatures at the 3-inch depth under clean cultivated is 13° colder than under ground cover such as oat stubble. This information is very important in establishing pest management programs for corn rootworms.

Oilseeds:

Sources of resistance to the Fall armyworm found in species related to peanuts - Tifton, Georgia. Evaluation of 14 species of Arachis for resistance to the fall armyworm showed that A. burkartii, A. villosa, and A. correntinia are resistant. Interspecific hybridization of peanuts with the section Arachis has been reported. Thus, A. villosa and A. correntinia offer potential for the transfer of fall armyworm resistance to cultivated peanuts.

Mexican bean beetle resistant soybeans released - Beltsville, Maryland. ARS and the Agricultural Experiment Stations of Illinois, Maryland, and Purdue released five jointly developed improved germplasm lines of soybeans with resistance to the Mexican bean beetle. The five lines being released were developed from crosses of two resistant plant introduction lines of cultivars adapted to northern States. The five true breeding F_6 lines were chosen for maximum resistance to Mexican bean beetle and improved agronomic performance.

Rearing procedures for the green stinkbug improved - Stoneville, Mississippi. As a result of research on nutritional requirements of the southern green stinkbug, Nezera virudula, the cost of rearing this insect has been reduced by nearly one-third. Research has shown that natural foods can be changed twice weekly and still allow adequate egg production. Initial research on the development of an artificial diet for this insect also appears promising. Laboratory cultures of this soybean pest are maintained for rearing exotic parasites for release in the field.

Role of parasites in regulating stinkbug populations identified - Stoneville, Mississippi. Study on the role of parasites and regulating populations of the rice stinkbug, Oebalus pugnax, showed that egg parasites contribute significantly to the natural mortality of this pest. More than 5,000 eggs were sampled from natural vegetation. Parasitism of egg masses was 61.1 % during the first sampling date, and 52.1, 56.0, and 69.0 during the three successive weekly sampling periods. The most important parasite species was Telenomus podisi.

High populations of threecornered alfalfa hopper not found to reduce yields - Stoneville, Mississippi. In field studies where field populations of the three-cornered alfalfa hopper occurred, none of nine popular varieties was reduced in yield. An average of plants girdled was 2.4 plants per row foot. These observations indicate that at levels where populations now occur, pest management actions for this insect are not warranted.

Sex attractants serve as effective monitoring tools for sunflower moth and beet armyworm moths - Bushland, Texas. (Z)-9,(E)-12-tetradecadien-1-ol is an effective monitoring tool for the sunflower moth, and this compound plus its acetate analogue, is an effective monitoring tool for the beet armyworm. Pheromone trapping showed that for the past three years peak sunflower moth activity at Bushland, Texas, has been between July 6 and 12.

Biochemical basis of resistance to sunflower moth in sunflowers identified - Bushland, Texas. Phytomelanin in the pericarp of sunflower achenes has been identified as the active component in sunflower resistance to the sunflower moth. Development of phytomelanin begins as early as three days after achene fertilization, but vast geotropic differences exist for rate of development and quantity produced. Toxicity of phytomelanin in immature achenes to early instar larvae of the sunflower moth is significant. This information will help breeders develop sunflower cultivars with resistance to this important pest.

Sorghum:

Sorghum germplasm lines with resistance to the sorghum midge is developed and released - Tifton, Georgia. Twenty-eight sorghum germplasm lines developed cooperatively and released by Texas A&M University will be registered for their high levels of resistance to the sorghum midge.

Sorghum germplasm with resistance to biotype E greenbugs identified - Lincoln, Nebraska. Approximately 2,160 grain sorghum lines and S_1 progenies were screened in the greenhouse for seedling resistance to biotype E greenbug. Nineteen of these lines survived heavy infestations of greenbugs. Subsequent testing of these biotype E resistant lines in the field demonstrated that the resistance persisted as the plant grew and matured. Crosses made from using these resistant lines as parents were resistant to biotype E greenbug, an indication that resistance is heritable and dominant. Some of the lines are expected to be released soon to the sorghum industry.

Chinch bug found to severely reduce grain yields - Lincoln, Nebraska. The effects of the chinch bug, Blissus leucopterus, upon yield of sorghum was determined by exposing plants of 7.5-12.5 cm extended height to 5 or 10 bugs per plant for seven days. Surviving plants reached normal height and maturity after bug removal, but yields were reduced 35 and 58% by 5 and 10 chinch bugs, respectively. Nymphs and adults caused similar damage. In a similar experiment 132 commercial grain sorghum hybrids planted May 28 in large replicated split design field tests were naturally infested with adult chinch bugs in late June

when the entries were in the seedling stage. Although the bug infestation was considered light by averaging less than 1 adult per seedling, the plants turned purple, wilted, and some died and caused thin stands even though the chinch bug infestation was eliminated by applying insecticides five days after the initial infestation. In a few days, surviving plants appeared to recuperate and remain normal in appearance until time of harvest. The combined yields of grain harvested by plot for 123 of the entries, however, were reduced by an average of 21%. The results of these two experiments indicate that selection of plants for resistance to chinch bugs cannot be made solely on visual appearance, but grain yield of the mature plant must be taken into account.

Pearl millet cultivars with chinch bug resistance - Stillwater, Oklahoma. In 1981 S_4 selections of pearl millet from a population with superior yield and with major dominant genes for chinch bug resistance were increased for release. At least one selection, 96R, is also segregating for biotype C and E greenbug resistance. Sources of resistance will be valuable in crossing for forage seed production.

Small grains:

New gene identified in wheat for resistance to Hessian fly - West Lafayette, Indiana. A new gene, H_{12}, from Luso wheat increases our supply of genetic stock of resistant wheat for the eastern soft wheat region. Genes H_9, H_{10}, H_{11}, and H_{12} are resistant to all known types of Hessian fly.

Wheat surveys indicate high incidence of Hessian fly resistance in wheats protects entire crops - West Lafayette, Indiana. Wheat surveys in Illinois, Indiana, Michigan, and Ohio show that the mean percent infestation for 1,277 certified wheat fields in the midwest was only 2.1%. This demonstrates the protection Hessian fly-resistant varieties are giving to the wheat crop in these States.

Genetics and expression of resistance to Hessian fly in wheat derived from Triticum tauschii is determined - Manhattan, Kansas. Hessian fly resistance derived from Triticum tauschii, the donor of the D-genome in common wheat, was found to be conditioned by a single dominant gene. This single factor of resistance represents a new source of genetic resistance to Hessian fly that can be readily transferred to hexaploid wheat. T. tauschii resistance is expressed as larval antibiosis, resistant to all known biotypes, and is stable at high temperature. Wheat germplasm having T. tauschii resistance has been released to breeders and will provide a broader base of genetic resistance to Hessian fly than was previously available.

Cereal leafbeetle research fulfills its mission - East Lansing, Michigan. After 17 years, the Federal cereal leafbeetle research program has been terminated. In the past 10 years, the beetle has damaged small grains in only a few States; for example, in 1980 and 1981 insecticides were used on less than 50,000 acres in Virginia and Maryland to suppress the beetle. Parasitoids introduced from Europe appear to have helped reduce the beetle numbers to a sub-economic level

throughout most of its American distribution. The host plant resistance program has identified excellent germplasm in wheat that could be bred quickly into commercial cultivars should the beetle population increase to more damaging status. Some resistant germplasm is available in barley. However, additional development will be needed before a commercial barley could be released. One line of Avena sterilis is somewhat resistant to the cereal leafbeetle because of the presence of long trichomes on the leaf surfaces.

Economic injury level determined for fall and spring infestation of greenbugs - Stillwater, Oklahoma. The green weight, number of tillers, and number of seeds per head were significantly reduced in winter wheat by either fall or spring greenbug infestations. The fall economic threshold for wheat was 1-10 greenbugs per plant. Heavy greenbug infestation in the fall causes critical injury to wheat plants and results in substantial yield losses. This carryover damage from fall to harvest and its effect on yields is greater than expected. The spring economic threshold is 10 greenbugs per plant. Greenhouse studies have shown that yield reduction produced by greenbug damage is probably an indirect result of decreased growth weight, decreased foliage weight, and decreased root weight of the wheat plant. The portions of the wheat plant below the soil are affected at least equal to those parts above the soil. Root weight and volume was decreased by up to 68% with heavy greenbug infestations.

Sugar:

A new parasite of the sugarcane borer released in Florida - Canal Point, Florida. A new parasite, Iphiaulax kimbali, was released in a 65-acre field of sugarcane on October 30, 1981. The area will be surveyed to determine the establishment and efficiency of the parasite.

Grasses and Legumes:

Fall armyworm resistance in centipedegrass demonstrated - Tifton, Georgia. Plant resistance in common centipedegrass, Eremochola ophiuroides, to the fall armyworm was demonstrated. Both antibiosis and nonpreference mechanisms of resistance were found. Thus, centipedegrass is an excellent source of resistance to this insect.

Source of resistance to the fall armyworm in bermudagrass located - Tifton, Georgia. Nine bermudagrass lines were evaluated for resistance and susceptibility to the fall armyworm. PI 290884, commonly known also as 292 Bermuda, was found to be highly resistant to fall armyworm feeding. None of the larvae feeding on PI 290884 survived to pupation.

Alfalfa found to have differential response to the green and red forms of the pea aphid - Beltsville, Maryland. Alfalfa lines or cultivars which have been developed for resistance to the green form of the pea aphid varied in response to the red form of the pea aphid that was collected on alfalfa in Maryland. Alfalfas BAA-15, BA-1, and CUF-101 were highly resistant to both the green and red form, whereas Arc, Kanza, Team, Wl-312, and Wl-318 were resistant to the

green form and susceptible to the red form. Two alfalfa populations, however, developed from intercrosses of plants selected from Arc, Kanza, Ranger, and Team, demonstrated resistance to the red form. These results indicate that it would be possible to develop alfalfa cultivars with resistance to both forms of the pea aphid if the red form should become dominant in field populations.

Resistance to the greenbug identified in Kentucky bluegrass cultivars - Beltsville, Maryland. Forty-seven Kentucky bluegrass cultivars were screened in the laboratory for resistance to the greenbug. Plants with moderate to high levels of resistance were selected from 33 of the 47 cultivars. Over 600 of these selections were established in the field for trials. They will be evaluated for agronomic performance, greenbug resistance, and response to naturally occurring diseases. The best selections will provide important sources of germplasm for incorporating greenbug resistance into new Kentucky bluegrass cultivars.

Population dynamics of natural populations of grasshoppers elucidated - Bozeman, Montana. A method was developed for estimating initial and final density, average longevity, and mean daily rates of survival among instars of a natural population of grasshoppers. Longevity of nymphs ranged from 6.3 to 13.6 (mean = 9.0 days/instar) and longevity of adults seldom exceeded three weeks (mean = 17.1 days). Survival rates ranged from 96.4% to 59.5%/day. If we assume that the migratory grasshopper, Melanoplus sanguinipes, reaches sexual maturity after 16 days in the adult stage, produces an average of 2.2 eggs per female per day thereafter and eggs suffer 38% mortality, a survival rate of 0.95457 will allow a generation to exactly reproduce itself. If significant economic injury begins at 30 days after hatch, cumulative seasonal injury will average 0.235 grams of forage destroyed per hatchling. If we could decrease the average survival rate by as little as 0.01 per day over the total period of damage, seasonal injury would be reduced by about 41% in constrast to a 35% reduction of damage when a 100% effective control (such as an insecticide) is applied after the majority of grasshoppers have become young adults. Sixty-five percent of the damage caused by grasshoppers occurs before they reach the adult stage. A biological antagonist could have great potential in grasshopper control if it reduced the survival rate throughout the grasshopper's life cycle.

Alfalfa blotch leafminer shown to cause significant yield and quality losses in alfalfa - University Park, Pennsylvania. Evaluations of losses due to alfalfa blotch leafminer have been difficult to assess and some controversy regarding the pest status of this insect has existed in tests at University Park, Pennsylvania. It has been found that the alfalfa blotch leafminer significantly reduced the yield of digestible dry matter and crude protein of field alfalfa. By an opposite leaflet technique, losses from leaflets infested with one leafminer were estimated to be 11% digestible dry matter, 12% crude protein, and 22% chlorophyll. Therefore, this insect must be considered a significant pest of alfalfa.

Introduced Russian wild ryes not preferred by grassbugs - Logan, Utah. Two varieties of Russian wild rye, Elymus junceus, ('Bozoisky' and 'Vinall') were tested in the laboratory with thirteen other rangeland grasses for preference by the black grassbug, Labops hesperius. When leaf damaged areas were used as an indication of preference, the 'Bozoisky' variety was least preferred having only about 7% as much damage as did the most heavily damaged variety, Great Basin wild rye (Elymus junceus). 'Vinall' had slightly more damage than did 'Bozoisky' but it also was not preferred by the black grassbug.

Techniques developed to quantitatively evaluate effects of black grassbug feeding - Logan, Utah. Black grassbug damage has been observed in intermountain rangelands for more than a decade; however, little work has been done to document quantitatively what this damage means in terms of the effect on the physiology of the plant. Work begun at Logan, Utah, this past year has provided the first quantitative documentation of the physiological response of important range forage grasses to black grassbug feeding. Laboratory techniques were developed to allow black grassbugs to feed on attached grass leaves. Feeding chambers were designed to minimize effects on leaves while at the same time allowing careful control of number of insects and feeding time. Grass exchange procedures were used to evaluate the impact of black grassbug feeding on photosynthetic carbon gain and transpirational water loss from the damaged portion of the leaf. Validation of these laboratory results is obtained from field gas exchange measurements made on plants growing on rangeland infested with black grassbugs. These measurements have allowed the first quantitative documentation of the effects of black grassbug damage on important physiological responses.

PUBLICATIONS

Tucson, Arizona

Ellsbury, Michael M., and Mervin W. Nielson. 1981. Comparative host plant range studies of the blue alfalfa aphid, Acyrthosiphon kondoi Shinji, and the pea aphid, Acyrthosiphon pisum (Harris) (Homoptera:Aphididae). USDA Tech. Bull. 1639. 14 pp.

Nielson, M. W. 1981. A new leafhopper species of Sandersellus from Panama (Cicadellidae: Coelidiinae: Sandersellini). J. Kans. Entomol. Soc. 53(3):658-660.

Nielson, M. W. 1981. Taxonomy of Jassus varicolor Spangberg with description of a new species in the genus Conbalia Nielson (Homoptera: Cicadellidae: Coelidiinae). J. Kans. Entomol. Soc. 54(1):27-31.

Canal Point, Florida

Sosa, O., Jr. 1981. Insect pests of sugarcane in the Western Hemisphere. Proc. Second Inter-American Sugar Cane Seminar-Insect and Rodent Pests, Miami, FL.

Tifton, Georgia

Altieri, M. A., W. J. Lewis, D. A. Nordlund, R. C. Gueldner, and J. W. Todd. 1981. Chemical interactions between plants and Trichogramma wasp in Georgia soybean fields. Prot. Ecol. 3:259-263.

Beevers, M., W. J. Lewis, H. R. Gross, and D. A. Nordlund. 1981. Kairomones and their use for management of entomophagous insects: X. Laboratory studies on manipulation of host-finding behavior of Trichogramma pretiosum Riley with a kairomone extracted from Heliothis zea (Boddie) moth scales. J. Chem. Ecol. 7:635-648.

Carpenter, J. E., A. N. Sparks, and E. A. Harrell. 1981. The effect of temperature on the wingbeat frequency and sustained flight of certain lepidopterous insects. J. Georgia Entomol. Soc. 16:451-457.

Chalfant, Richard B., and John R. Young. 1981. Chemigation to manage insect pests on vegetables: Peanuts and soybeans. Proc. Natl. Symposium on Chemigation.

Gardner, W. A., B. R. Wiseman, P. B. Martin, and E. F. Suber. 1981. Identification and control of lepidopterous pests of grain sorghum. Proc. of the Grain Sorghum Short Course. Edited by R. R. Duncan, Univ. Ga. Spec. Publ. 8:11-16.

Gueldner, R. C., and W. L. Parrott. 1981. Constituents of mustard, goldenrod, and croton, three host plants of the tarnished plant bug. J. Agric. Food Chem. 29:418-20.

Johnson, A. W., J. R. Young, and B. G. Mullinix. 1981. Applying nematicides through an overhead sprinkler irrigation system for control of nematodes. J. Nematol. 13:154-159.

Johnson, J. C., W. C. McCormick, and J. R. Young. 1981. Nutritive value of summer planted crops of adapted and exotic corn ensiled before and after freezing. Univ. Ga. Res. Bull. 264. 18 pp.

Johnson, J. W., G. L. Teetes, D. T. Rosenow, and B. R. Wiseman. 1981. Response of selected sorghum genotypes to midge and greenbug infestations. Sorghum Newsl. 24:83.

Johnson, J. W., G. L. Teetes, B. R. Wiseman, and J. M. Phillips. 1981. Performance of midge resistant sorghum hybrids. Annual HPR Newsl. 7:42.

Loh, L. C., J. J. Hamm, and E. S. Huang. 1981. Spodoptera frugiperda nuclear polyhedrosis virus genome: physical maps for restriction endonucleases Bam HI and Hind III. J. Virol. 38:922-931.

McMillian, W. W., N. W. Widstrom, and D. M. Wilson. 1981. Rearing the maize weevil on maize genotypes when aflatoxin-producing Aspergillus flavus and A. parasiticus isolates were present. Environ. Entomol. 10:760-762.

McMillian, W. W., N. W. Widstrom, and D. M. Wilson. 1981. Aflatoxin found in preharvest grain sorghum. Sorghum Newsl. 24:123.

McMillian, W. W., B. R. Wiseman, and N. W. Widstrom. 1981. An evaluation of selected sorghums for multiple pest resistance. Fla. Entomol. 64:198-199.

Nordlund, D. A., W. J. Lewis, H. R. Gross, Jr., and M. Beevers. 1981. Kairomones and their use for management of entomophagous insects: XII. The stimulatory effects of host eggs and the importance of host-egg density to the effective use of kairomones for Trichogramma pretiosum Riley. J. Chem. Ecol. 7:909-917.

Nordlund, D. A., and C. E. Sauls. 1981. Kairomones and their use for management of entomophagous insects: XI. Effect of host plants on the kairomonal activity of frass from Heliothis zea larvae for the parasitoid Microplitis croceipes. J. Chem. Ecol. 7:1057-1061.

Suber, E. F., W. A. Gardner, B. R. Wiseman, and P. B. Martin. 1981. The sorghum midge. Proc. of the Grain Sorghum Short Course. Edited by R. R. Duncan, Univ. Ga. Spec. Publ. 8:17-19.

Waiss, A. C., Jr., B. G. Chan, C. A. Elliger, D. L. Dreyer, R. G. Binder, and R. C. Gueldner. 1981. Insect growth inhibitors in crop plants. ESA Bull. 27:217-21.

Widstrom, N. W., W. W. McMillian, and B. R Wiseman. 1981. The influence of timely harvest on maize weevil feeding and fecundity on corn. J. Ga. Entomol. Soc. 16:234-239.

Widstrom, N. W., D. M. Wilson, and W. W. McMillian. 1981. Aflatoxin contamination of preharvest corn as influenced by timing and method of inoculation. Appl. Environ. Microbiol. 42:249-251.

Widstrom, N. W., B. R. Wiseman, W. W. McMillian, C. A. Elliger, and A. C. Waiss, Jr. 1981. Variations among corn silk genotypes for maysin, a compound antibiotic to the corn earworm. Agron. Abstr. 1981:76.

Wilson, D. M., N. W. Widstrom, L. R. Marti, and B. D. Evans. 1981. Aspergillus flavus group, aflatoxin, and bright greenish yellow fluorescence in insect-damaged corn in Georgia. Cereal Chem. 58:40-42.

Wiseman, B. R. 1981. Infestation of FAW in sorghum: Greenhouse and field methods. 12th Biennial Grain Sorghum Res. and Util. Conf. 12:98.

Wiseman, B. R., R. C. Gueldner, and R. E. Lynch. 1981. Resistance in common centipedegrass to the fall armyworm. J. Econ. Entomol. 74:

Wiseman, B. R., and W. P. Morrison. 1981. Components for management of field corn and grain sorghum insects and mites in the United States. USDA-ARS. Agric. Rev. Manuals. ARM-S-18. 18 pp. ISSN 0193-3779.

Wiseman, B. R., N. W. Widstrom, and W. W. McMillian. 1981. Influence of corn silks on corn earworm feeding response. Fla. Entomol. 64:395-99.

Wiseman, B. R., N. W. Widstrom, and W. W. McMillian. 1981. Effects of 'Antigua 2D-1,18' resistant corn on fall armyworm feeding and survival. Fla. Entomol. 64:515-519.

Wiseman, B. R., N. W. Widstrom, and W. W. McMillian. 1981. A summary of host plant resistance-alfatoxin and genetics project at Tifton, GA. Ann. Plant Resistance to Insects Newsl. 7:9-16.

Wiseman, B. R., W. P. Williams, and F. M. Davis. 1981. Fall armyworm: Resistance mechanisms in selected corns. J. Econ. Entomol. 74:622-25.

Young, John R. 1981. Chemigation: Insecticides applied in irrigation water for control of the corn earworm and fall armyworm in sweet and field corn. Proc. Nat. Symposium on Chemigation 1:56-64.

Young, John R. (ed.). 1981. Proceedings of the National Symposium on Chemigation. Vol. 1. 126 pp.

Young, J. R., T. C. Keisling, and J. R. Stansell. 1981. Insecticide application with sprinkler irrigation systems. Trans. ASAE 24:120-123.

Kimberly, Idaho

Blickenstaff, C. C., R. E. Peckenpaugh, Del Traveller, and J. D. Stallings. 1981. Insecticide tests for control of the sugarbeet root maggot, 1968-1978. USDA, SEA, ARR-W-18. 75 pp.

Blickenstaff, C. C. and R. E. Peckenpaugh. 1981. Insecticide tests for control of the western bean cutworm. USDA, SEA, ARR-W-21. 31 pp.

West Lafayette, Indiana

Carrigan, L. L., H. W. Ohm, J. E. Foster, and F. L. Patterson. 1981. Response of winter wheat cultivars to barley yellow dwarf virus infection. Crop Sci. 21:377-380.

Gallun, R. L., and F. L. Patterson. 1981. Utilizing the coevolution of wheats and the Hessian fly biotypes as a tool for developing resistant wheat cultivars in the rainfed areas of the United States. Proc. of the Third International Wheat Conf., Madrid, Spain. Printed by Nebr. Agric. Exp. Stn.

Ankeny, Iowa

Beegle, C. C., L. C. Lewis, R. E. Lynch, and A. J. Martinez. 1981. Interaction of larval age and antibiosis on the susceptibility of three insect species to Bacillus thuringiensis. J. Invertebr. Pathol. 37:143-53.

Guthrie, W. D. 1981. Mass rearing of crop pests with emphasis on stem and pod borers. Insect science and its application. Int. J. Tropical Insect Sci.

Guthrie, W. D. 1981. Maize whorl stage resistance to the first four instars of European corn borer larvae (Lepidoptera:Pyralidae). J. Kan. Entomol. Soc. 54:737-40.

Guthrie, W. D., D. Barry, and J. L. Huggans. 1981. Hybridization studies between Ostrinia nubilalis, Ostrinia obumbratalis, and Ostrinia penitalis (Lepidoptera:Pyralidae). . J. Kan. Entomol. Soc. 54:505-9.

Guthrie, W. D., E. B. Lillehoj, W. W. McMillian, D. Barry, W. F. Kwolek, A. O. Franz, E. A. Catalano, W. A. Russell, and N. W. Widstrom. 1981. Effect of hybrids with different levels of susceptibility to second-generation European corn borers on alfatoxin contamination in corn. J. Agric. Food Chem. 29:1170-1172.

Jones, J. A., W. D. Guthrie, and T. A. Brindley. 1981. Postembryonic development of the reproductive system of female European corn borers. ARR-NC-7. SEA, USDA. 15 pp.

Reed, G. L., W. D. Guthrie, W. B. Showers, D. Barry, and D. F. Cox. 1981. Sex linked inheritance of diapause in the European corn borer: Its significance to diapause physiology and environmental response of the insect. Ann. Entomol. Soc. Am. 74:1-8.

Oellermann, C. M., F. L. Patterson, and R. L. Gallun. 1981. Inheritance of resistance in Luso wheat to Hessian fly. Agron. Abstr. 1981. p. 69.

Sharia, M. R., M. Lister, J. E. Foster, and G. E. Shaner. 1981. Comparative virus content of cereal cultivars infected with barley yellow dwarf virus. Phytopathology 71:904.

Stebbins, N. B., F. L. Patterson, and R. L. Gallun. Interrelationships among wheat genes H_3, H_5, H_6, H_9, H_{10}, and H_{11} for resistance to Hessian fly. Agron. Abstr. 73:74.

Manhattan, Kansas

Hatchett, J. H., R. L. Burton, and K. J. Starks. 1981. Hessian fly: Distribution and infestation of wheat in Oklahoma and north Texas. The Southwest. Entomol. 6(1):34-37.

Hatchett, J. H., and B. S. Gill. 1981. D-genome sources of resistance in Triticum tauschii to Hessian fly. J. Hered. 72:126-127.

Hatchett, J. H., T. J. Martin, and R. W. Livers. 1981. Expression and inheritance of resistance to Hessian fly in synthetic hexaploid wheats derived from Triticum tauschii. Crop Sci. 21:731-734.

Houma, Louisiana

Hensley, S. D. 1981. Management of sugarcane insect pests. Sugar J. 44:18.

Hensley, S. D., G. R. Gaudin, C. K. Finger, and J. W. Sanford. 1981. Efficacy and effects of selected non-target organisms of azinphosmethyl (guthion) and pydrin applied for full-season control of the sugarcane borer. Entomol. Soc. Am. Insecticide and Acaricide Tests 6(301):151.

Roe, R. M., A. M. Hammond, T. E. Reagan, and S. D. Hensley. 1981. A bibliography of the sugarcane borer, Diatraea saccharalis (Fabricius) 1887-1980. U. S. Dep. Agric, Agric. Rev. and Manuals. ARM-S-20.

Beltsville, Maryland

Baker, P. B., R. H. Ratcliffe, and A. L. Steinhauer. 1981. Tolerance to hairy chinch bug feeding in Kentucky bluegrass. Environ. Entomol. 10:153-157.

Baker, P. B., R. H. Ratcliffe, and A. L. Steinhauer. 1981. Laboratory rearing of the hairy chinch bug. Environ. Entomol. 10:226-29.

Elden, T. C., and J. H. Elgin, Jr. 1981. Laboratory selection for potato leafhopper resistance in alfalfa. 44th Annual Report of Forage Research in Northeastern U.S.

Ratcliffe, R. H., and T. C. Elden. 1981. Report on research on plant resistance to the potato leafhopper and alfalfa weevil in alfalfa. 18th Northeast Regional Invitation Alfalfa Insects Conference, October 20-21.

Ratcliffe, R. H., and J. J. Murray. 1981. Laboratory selection for greenbug resistance in Kentucky bluegrass. 44th Annual Report of Forage Research in Northeastern U.S.

Ratcliffe, R. H., and J. J. Murray. 1981. Field evaluation of perennial ryegrass and fineleaf fescue varieties for hairy chinch bug resistance. 44th Annual Report of Forage Research in Northeastern U.S.

East Lansing, Michigan

Wellso, S. G., and R. P. Hoxie. 1981. Diapause and nondiapause behavior of the cereal leaf beetle. Ent. Exp. & Appl. 30:19-25.

Wellso, S. G., and R. P. Hoxie. 1981. Cereal leaf beetle pupation under controlled temperatures and relative humidities. Environ. Entomol. 10:58-61.

Mississippi State, Mississippi

Thompson, A. C., and F. M. Davis. 1981. The effect of temperature on the rate of metabolism of lipids and glycogen in Diatraea grandiosella. Comp. Biochem. Physiol. 70A:555-58.

Williams, W. P., and F. M. Davis. 1981. Evaluation of commercial corn hybrids for resistance to leaf feeding by the southwestern corn borer and the fall armyworm. MAFES Res. Rep. Vol. 5, No. 16. 3 pp.

Wiseman, B. R., W. P. Williams, and F. M. Davis. 1981. Fall armyworm: Resistance mechanisms in selected corns. J. Econ. Entomol. 74:622-24.

Stoneville, Mississippi

McWilliams, J. M., C. W. Gantt, and E. A. Stadelbacher. 1981. Heliothis virescens: Oviposition and egg collection system. J. Ga. Entomol. Soc. 16:386-391.

Columbia, Missouri

Starks, K. J., J. W. Johnson, R. L. Burton, B. D. Barry, and S. Sotomayor-Rios. 1981. Studies of biotype C greenbug resistance in African sorghum. Proc. Twelfth Biennial Grain Sorghum Res. and Util. Conf., Lubbock, TX (Feb. 24-27)

Bozeman, Montana

Henry, J. E., and E. A. Oma. 1981. Pest control by Nosema locustae, a pathogen of grasshoppers and crickets. In Microbial Control of Pests and Plant Diseases 1970-1980, H. D. Burges, ed.

Hopkins, A. R., J. A. Onsager, R. F. Moore, and W. James. 1981. Comparison of spatial distribution of Heliothis spp. larvae and injured squares in cotton as estimated by three sampling methods. J. Econ. Entomol. 74:409-420.

Onsager, J. A. 1981. A note on the Poisson distribution in integrated pest management. Bull. Entomol. Soc. Am. 22:417-421.

Lincoln, Nebraska

Brown, D. E., W. R. Kehr, and G. R. Manglitz. 1981. Isolation requirements for foundation alfalfa seed fields. Crop Sci. 21:628-629.

Manglitz, G. R. 1981. Book Review: Breeding plants resistant to insects. Bull. Entomol. Soc. Am. 27:230.

Manglitz, G. R., L. E. Klostermeyer, and D. L. Keith. 1981. Comparisons of eastern and western alfalfa weevil in Nebraska. J. Econ. Entomol. 74(5):581-588.

Wooster, Ohio

Findley, W. R., R. Louie, J. K. Knoke, and G. J. Ryder. 1981. Performance of corn hybrids exposed to corn viruses in Ohio in 1980. Agronomy Department Series 213. Ohio Agric. Res. Dev. Cent. 8 pp.

Knoke, J. K., R. J. Anderson, W. R. Findley, R. Louie, J. J. Abt, and D. T. Gordon. 1981. The reaction of sweet corn hybrids to maize dwarf mosaic virus strains and maize chlorotic dwarf virus. Ohio Agric. Res. Dev. Cent. Res. Bull. 1135. 22 pp.

Knoke, J. K., and R. Louie. 1981. Epiphytology of maize virus diseases. Pages 92-102 in D. T. Gordon, J. K. Knoke, and G. E. Scott, eds. Virus and viruslike diseases of maize in the United States. Sout. Coop. Ser. Bull. 247. 218 pp.

Knoke, J. K., R. Louie, L. V. Madden, and D. T. Gordon. 1981. The spread of maize dwarf mosaic virus from johnsongrass to maize. Phytopathology 71:886.

Louie, R., and J. K. Knoke. 1981. Solid stream inocula for transmission of maize dwarf mosaic virus. Phytopathology 71:891.

Louie, R., and J. K. Knoke. 1981. Symptoms and disease diagnosis. Pages 13-18 in D. T. Gordon, J. K. Knoke, and G. E. Scott, eds. Virus and viruslike diseases of maize in the United States. South. Coop. Ser. Bull. 247. 218 pp.

Stillwater, Oklahoma

Boozaya-Angoon, D., K. J. Starks, L. H. Edwards, and H. Pass. 1981. Inheritance of resistance in oats to two biotypes of the greenbug. Environ. Entomol. 10:557-559.

Burton, R. L., and D. J. Schuster. 1981. Oviposition stimulant for tomato pinworms from surfaces of tomato plants. Ann. Entomol. Soc. Am. 74:512-515.

Champlin, F. R., P. Y. K. Cheung, S. Pekrul, R. J. Smith, R. L. Burton, and E. A. Grula. 1981. Virulence of Beauveria bassiana mutants for the pecan weevil. J. Econ. Entomol. 74:617-621.

Peters, D. C., and K. J. Starks. 1981. Pest management systems for sorghum insects. pp. 549-562. In: Pimental, D. (ed.) Handbook of pest management, CRC Press, Inc. Boca Raton, Fla. 656 pp.

Racioppi, J. V., R. L. Burton, and R. Eikenberry. 1981. The effects of various oligidic synthetic diets on the growth of Hippodamia convergens. Ent. Exp. Appl. 30:68-72.

Wilson, R. L., and K. J. Starks. 1981. Effect of culture-host preconditioning on greenbug response to different plant species. Southwest. Entomol. 6:229-232.

University Park, Pennsylvania

Plummer, J. A., and R. A. Byers. 1981. Seasonal abundance and parasites of the alfalfa blotch leafminer, Agromyza frontella, in central Pennsylvania. Environ. Entomol. 10:105-110.

Reed, H. E., and R. A. Byers. 1981. Flea beetles attacking forage kale: Effect of carbofuran and tillage methods. J. Econ. Entomol. 74:334-337.

Brookings, South Dakota

Branson, T. F., J. R. Fisher, A. L. Kahler, and G. R. Sutter. 1981. Host plant resistance to corn rootworms. Proc. 17th Annual Ill. Corn Breeders School, Univ. Ill. pp. 76-110.

Branson, T. F., G. R. Sutter, and J. R. Fisher. 1981. Nondiapause eggs of western corn rootworms in artificial field infestations. Environ. Entomol. 10:94-96.

Fisher, J. R. 1981. Systems for extracting corn rootworm larvae from soil samples. J. Econ. Entomol. 74:103-105.

Gustin, R. D. 1981. Soil temperature environment of overwintering western corn rootworm eggs. Environ. Entomol. 10:483-487.

Kieckhefer, R. W., and J. R. Thysell. 1981. Host preferences and reproduction of four cereal aphids in 20 triticale cultivars. Crop Sci. 21:322-324.

Kirk, V. M. 1981. Base of corn stalks as oviposition sites for western and northern corn rootworms (Diabrotica Coleoptera). J. Kansas Entomol. Soc. 54:255-262.

Krysan, J. L. 1981. A collector/mailing container for shipment of live insects. Entomol. News. 92:121-123.

Sutter, G. R., T. F. Branson, J. R. Fisher, and A. L. Kahler. 1981. New developments in corn rootworm biology, host plant resistance, and chemical control using artificial infestation. Proc. 35th Ann. Corn and Sorghum Res. Conf. pp. 101-115.

Bushland, Texas

Kreitner, G. L., and C. E. Rogers. 1981. Sunflower seed midge: Effects of larval infestation on pericarp development in sunflowers. Ann. Entomol. Soc. Am. 74:431-435.

Rogers, C. E. 1981. Resistance of sunflower species to the western potato leafhopper. Environ. Entomol. 10:697-700.

Rogers, C. E., and G. L. Kreitner. 1981. A physical basis for pericarp resistance to the sunflower moth, pages 17-18. Proc. Sunflower Forum and Research Workshop. 27 pages. Sunflower Assoc. Am.

Rogers, C. E., and E. W. Underhill. 1981. A sex attractant for monitoring beet armyworm populations. Southwest. Entomol. 6:211-214.

GERMPLASM RELEASES

Ankeny, Iowa

Ohm, H. W., F. L. Patterson, L. L. Carrigan, G. E. Shaner, J. E. Foster, R. E. Finney, and J. J. Roberts. 1981. Registration of Elmo common wheat germplasm. Crop Sci. 21:803.

Patterson, F. L., H. W. Ohm, G. E. Shaner, R. E. Finney, and J. J. Roberts. 1981. Registration of Benni common wheat germplasm. Crop Sci. 21:802-803.

Patterson, F. L., H. W. Ohm, G. E. Shaner, R. E. Finney, R. L. Gallun, J. J. Roberts, and J. E. Foster. 1981. Caldwell soft red winter wheat. Purdue Univ. Agric. Exp. Stn. Bull. 328. 16 pp.

Patterson, F. L., G. E. Shaner, H. W. Ohm, R. E. Finney, R. L. Gallun, J. J. Roberts, and J. E. Foster. Auburn soft red winter wheat. Purdue Univ. Agric. Exp. Stn. Bull. 329. 18 pp.

Roberts, J. J., R. L. Gallun, F. L. Patterson, R. E. Finney, H. W. Ohm, and G. E. Shaner. 1981. Registration of Downy wheat. Crop Sci. 31:350.

Mississippi State, Mississippi

Scott, G. E., and F. M. Davis. 1981. Registration of Mp SWCB-4 population of maize (*Zea mays* L.). Crop Sci. 21:148.

Scott, G. E., and F. M. Davis. 1981. Registration of Mp 496 inbred of maize (*Zea mays*). Crop Sci. 21:353.

Lincoln, Nebraska

Kehr, W. R., G. R. Manglitz, and R. L. Ogden. 1981. Registration of Perry alfalfa. Crop Sci. 21:628-629.

PRINCIPAL CONTACTS - NRP 20240

Tucson, Arizona	Dr. M. W. Nielson, RL USDA-ARS-WR 2000 East Allen Road Tucson, AZ 85719 Tel.: 602-792-6272 FTS: 762-6272
Canal Point, Florida	Dr. O. Sosa USDA-ARS-SR Star Route, Box 8 Canal Point, FL 33438 Tel.: 305-924-5227
Tifton, Georgia	Dr. A. N. Sparks, LD, RL USDA-ARS-SR Georgia Coastal Plain Experiment Station Tifton, GA 31794 Tel.: 912-382-6904
Kimberly, Idaho	Dr. C. C. Blickenstaff, RL USDA-ARS-NCR Rt. 1, P.O. Box 186 Kimberly, ID 83341 Tel.: 208-423-5582 FTS: 554-6578
West Lafayette, Indiana	Dr. R. L. Gallun, RL USDA-ARS-NCR Agricultural Admin. Building Purdue University West Lafayette, IN 47907 Tel.: 317-494-8230
Ankeny, Iowa	Dr. W. D. Guthrie, RL USDA-ARS-NCR Box 45B, RR #3 Ankeny, IA 50021 Tel.: 515-284-4758 FTS: 862-4758
Manhattan, Kansas	Dr. J. Hatchett USDA-ARS-NCR Plant Pathology Department Kansas State University Manhattan, KS 66506 Tel.: 913-532-6176 FTS: 752-4277

Crowley, Louisiana	Dr. J. F. Robinson USDA-ARS-SR Rice Experiment Station P.O. Box 1429 Crowley, LA 70526 Tel.: 318-783-4373 FTS: 687-6648
Houma, Louisiana	Dr. S. D. Hensley, RL USDA-ARS-SR U.S. Sugarcane Field Laboratory P.O. Box 470 Houma, LA 70361 Tel.: 504-872-5042
Beltsville, Maryland	Dr. R. H. Ratcliffe USDA-ARS-NER Field Crops Laboratory Room 207, Bldg. 467, BARC-East Beltsville, MD 20705 Tel.: FTS: 344-2392
East Lansing, Michigan	Dr. S. G. Wellso, RL USDA-ARS-NCR Department of Entomology Michigan State University East Lansing, MI 48824 Tel.: 517-353-0860 FTS: 373-0860
Stoneville, Mississippi	Dr. E. G. King, LD, RL USDA-ARS-SR Bioenvironmental Insect Control Laboratory P.O. Box 225 Stoneville, MS 38776 Tel.: 601-686-2311, ext. 231/2 FTS: 497-2231
Mississippi State, Mississippi	Dr. F. M. Davis USDa-ARS-SR Corn Host Plant Resistance P.O. Box 5367 Mississippi State, MS 39762 Tel.: 601-323-2230
Bozeman, Montana	Dr. J. A. Onsager, RL USDA-ARS-WR Rangeland Insect Laboratory Montana State University S. 11th Avenue Bozeman, MT 59717 Tel.: 406-994-3344 FTS: 585-4220

Columbia, Missouri	Dr. Dean Barry USDA-ARS-NCR Rm. 1-67, Agricultural Bldg. University of Missouri Columbia, MO 65211 Tel.: 314-882-3486 FTS: 276-3186
Lincoln, Nebraska	Dr. G. R. Manglitz (Forage) USDA-ARS-NCR Forage and Range Research Unit Department of Agronomy University of Nebraska Lincoln, NE 68583 Tel.: 402-472-2919 FTS: 541-5267
	Dr. S. D. Kindler (Sorghum) USDA-ARS-NCR Sorghum Research Unit Department of Agronomy University of Nebraska Lincoln, NE 68583 Tel.: 402-472-2919 FTS: 541-5263
Fargo, North Dakota	Dr. L. D. Charlet USDA-ARS-NCR Sunflower Insect Research Department of Entomology North Dakota State University Fargo, ND 58105 Tel.: 701-237-7904
Wooster, Ohio	Dr. J. K. Knoke USDA-ARS-NCR Ohio Agricultural Research and Development Center Wooster, OH 44691 Tel.: 216-264-2540
Stillwater, Oklahoma	Dr. K. J. Starks USDA-ARS-SR Plant Science Research Facility P.O. Box 1029 Stillwater, OK 74076 Tel.: FTS: 728-4126

Corvallis, Oregon	Dr. J. A. Kamm USDA-ARS-WR Oregon State University Corvallis, OR 97331 Tel.: FTS: 420-4824
University Park, Pennsylvania	Dr. R. A. Byers USDA-ARS-NER U.S. Regional Pasture Research Laboratory University Park, PA 16802 Tel.: 814-237-7683 FTS: 727-4607
Brookings, South Dakota	Dr. G. R. Sutter, RL USDA-ARS-NCR Northern Grain Insects Research Laboratory Rural Route 3 Brookings, SD 57006 Tel.: 605-693-3241
Bushland, Texas	Dr. C. E. Rogers USDA-ARS-SR Southwestern Great Plains Research Center Bushland, TX 79012 Tel.: 806-378-5724 FTS: 735-6724
Logan, Utah	Dr. J. D. Hansen USDA-ARS-WR Crops Research Laboratory Utah State University, UMC 63 Logan, UT 84322 Tel.: 801-750-3078
Yakima, Washington	Dr. A. K. Burditt USDA-ARS-WR Yakima Agricultural Research Laboratory 3706 W. Nob Hill Boulevard Yakima, WA 98902 Tel.: 509-575-5877 FTS: 446-5877

National Research Program 20250
BASIC/NON-COMMODITY RESEARCH FOR INSECT CONTROL

Technological Objective 1: Develop new and improved principles and practices of arthropod control based on the selective disruption of growth, development, and reproduction.

In the United States insects currently destroy an average of 13% of the potential yield of crops, reduce livestock production by 6%, and destroy 6% of commodities after harvest. Insects transmit many serious human and animal diseases.

Aggravating the difficulty in resolving pest control dilemas is the rapidity of obsolescence of technology for managing insect pests. Insect populations often develop an immunity or resistance to insecticides within 3 to 10 years after their introduction. In the same time period, new strains or biotypes of insects may evolve to overcome the resistance of specially developed cultivars.

Agricultural production and marketing technology are undergoing a technological revolution. Many changes that favor insect pests and diseases are being implemented on a wide scale. The progressive substitution of herbicides for cultivation, the increased use of irrigation, inorganic fertilizers, large monocultures, multiple cropping systems, and huge crowded feed lots and poultry houses all require major adjustments and innovations in the technology for controlling insects. During the next 25 years, major changes will occur in the regional patterns of production and insects will have to be fought under new circumstances. Insects that are new to the American scene will have to be confronted, for a major pest penetrates our quarantines on the average of every 3 years. Finally, as outdoor recreational activities continue to grow, new ways will have to be found to protect people who enter forests and fields and encounter insect vectors of arboviruses and other dangerous pathogens.

Opportunities for solving insect pest problems and resolving attendant dilemmas have never been so apparent as now. Superb instrumentation exists for identifying minute quantities of natural or synthetic chemicals, for monitoring the electrical and secretory behavior of individual cells, and for studying individual cells and organs in isolation from the many influences of the whole living body. Powerful means are becoming available for detecting low level infestations of insects and for accurately assessing the growth of pest populations. The mechanisms that regulate populations and the impact of control measures on population growth are becoming understood quantitatively. Means for selectively suppressing a pest species in the presence of bees and other beneficial insects are becoming available. Developments in computers, remote sensing technology, models of the production system, weather prediction, and communications technology are converging to provide systems that will surely revolutionize production, pest management, and marketing.

NPS Contact: Waldemar Klassen

Research Locations:

Gainesville, Florida
Beltsville, Maryland
Fargo, North Dakota

Examples of Recent Progress:

Fat body of host insects was found to provide factors essential to the growth and development of the endoparasite Apanteles marginiventris - Gainesville, Florida. Cocultured host fat body promotes the growth and development of parasite larvae and eggs. The host's fat body is histolyzed to release the fat body cells into the hemolymph. Moreover, the blood proteins of parasitized hosts are rapidly broken down. The hemolymph of the parasitized host was found to contain significant amounts of trypsin-like endopeptidases.

Tachinid fly endoparasite of lepidopterous pests was successfully reared in vitro from early second instar to apparently normal adult - Gainesville, Florida. Several individuals of Compsilura concinnata, an endoparasite of the gypsy moth and of many other lepidopterous pests, have been reared in vitro from the early second instar to the adult stage. (In cooperation with C. Williams, Harvard University).

The first cell lines from imaginal discs that retain the ability to respond to insect hormones were established - Gainesville, Florida. Insect cell lines can provide homogeneous populations of cells for the study of insect hormones. A difficulty with these types of studies has been that available cell lines have been developed from tissues such as embryos and young larvae, which contain cells in varied developmental states, and it is difficult to correlate in vitro results to the actual occurrence in vivo. The wing imaginal discs of insects, the undifferentiated cells in immature insects that are destined to become wings of the adult, were utilized to develop cell cultures in a particular development state. Cell lines were obtained from three Lepidoptera, the cabbage looper Trichoplusia ni, the fall armyworm Spodoptera frugiperda, and Indianmeal moth Plodia interpunctella. The former two grow in suspension as multicellular, fluid-filled vesicles formed from monolayers of epithelial-like cells. The Indianmeal moth cultures grow as attached monolayers of primarily small fibroblast-like cells. Exposure of the cabbage looper cell line (TND1) to 20-hydroxyecdysone stimulated the synthesis of specific new proteins, as revealed by two-dimensional gel electrophoresis. These proteins were the same as those stimulated by hormone in freshly dissected discs. TND1 is the first cell line established specifically from imaginal wing discs that retains the ability to respond to insect hormones.

Evidence suggests that the integrity of cytoskeletal system is essential for chitin synthesis and cuticle deposition - Gainesville, Florida. The relationship of the microtubule cytoskeletal system to the formation of cuticle was evaluated by culturing in vitro wing imaginal discs from the Indianmeal moth in medium that contained 20-hydroxyecdysone and either demecolcine or vinblastine. The cytoskeletal inhibitors prevented the formation of cuticle as ascertained with electron microscopy. Moreover, the synthesis of chitin from C^{14}-N-acetyl-D-glucosamine was inhibited by both demecolcine and vinblastine. Protein

synthesis was not inhibited by these agents. The evidence supports the hypothesis that the integrity of the cytoskeletal system must be maintained to permit chitin synthesis and cuticle deposition.

A new molting hormone was discovered in bugs (Hemiptera) - Beltsville, Maryland. Makisterone A has been identified as the molting hormone in Oncopeltus and other Hemiptera. Before this discovery, it was believed that the molting hormone in all insects was 20-hydroxyecdysone. It is now apparent that other ecdysteroids can serve as molting hormones in insects. This finding is of considerable importance to insect physiologists in that it broadens the role of ecydsteroids of physiological importance and opens up new interpretations of the evolutionary significance of molting hormones and their biosynthesis.

Molting was found to be regulated by different hormones in the two major groups of bugs (Hemiptera) - Beltsville, Maryland. A survey of the ecdysteroids present in species in the order Hemiptera was begun using high-performance liquid chromatography fractionation of blood samples and a nonspecific radioimmunoassay for detection of ecdysteroids. Thus far seven species from the two taxonomic groups of terrestrial Hemiptera have been studied: the large milkweed bug Oncopeltus fasciatus, the southern green stink bug Nezara viridula, the spined soldier bug Podisus maculiventris, and Dysderus cingulatus (Pentatomomorpha group); Rhodnius prolixus, Artilus cristatus and Cimex lectularius (Cimicomorpha group). Makisterone A is the major ecdysteroid in all Pentatomomorpha larvae and no 20-hydroxyecdysone was detected. In the Cimicomorpha group 20-hydroxyecdysone is the major ecdysteroid and makisterone A is undetectable.

Brassinolides were synthesized from oyster sterols - Beltsville, Maryland. Brassinolide (2α,3α,22α,23α-tetrahydroxy-24α-methyl-B-homo-7-oxa-5α-cholestan-6-one), a novel plant growth-promoting steroid isolated from rape pollen, and its hitherto unknown 22β,23β-isomer were synthesized from a C-24 epimeric mixture of 22-dehydrocampesterol and brassicasterol from oysters. The method of synthesis favored the formation of the 22β,23β-isomer by better than 4:1. This synthesis and previous syntheses have completed the series and made brassinolide and all of its 22,23-cis-glycolic isomers available for physiological studies. In two different bean bioassay systems, brassinolide, both natural and synthetic, was far more active than any of its 22,23-cis-glycolic isomers. (Cooperative research with Drs. N. B. Mandava and W. J. Meudt, Plant Hormone Laboratory, PPhI).

Chemical ionization mass spectra showed molecular ions of brassinosteroids - Beltsville, Maryland. The chemical ionization mass spectra (CI-MS) of a number of synthetic brassinosteroids showed molecular ions and verified their structures and the location of a cis-glycolic hydroxyl group in their side chain; electron impact mass spectra of brassinosteroids with glycolic hydroxyl groups in their side chain were of little use. CI-MS also readily differentiated 6-oxa and 7-oxa brassinosteroids.

A patent was issued for dimethyl alkane phosphonates as nematicides - Beltsville, Maryland. A patent has been issued on dimethyl alkane phosphonates,

one of the two previously reported classes of nematicides in which other functional groups replace the amine or amide moiety. Structure-activity work is continuing on the other class, not yet patented. Included is the most active compound yet tested in the Panagrellus screening assay. Formulation work is continuing in an attempt to improve activity in soil. (Cooperative research with Dr. J. Feldmesser, Nematology Laboratory, PPI).

Biosynthesis of molting hormones was found in testes - Beltsville, Maryland. The testes of Heliothis were identified as a new location of ecdysteroid synthesis. Before this discovery, the only sources of ecdysteroids in male insects were thought to be the prothoracic gland or the oenocytes. Now it is apparent that ecydsteroids can also be synthesized by other tissues. Because the regulatory mechanisms of spermatogenesis are unknown, this finding may be the first important clue to the role of ecdysteroids in such mechanisms.

A new class of insect molting inhibitors, the thiosemicarbazones, was discovered - Beltsville, Maryland. Structure-activity studies have shown that these compounds are highly specific and that their activity may represent a new approach to controlling pest insects. Since no insect growth regulator is known to possess such physiological effects, these materials represent an important tool for exploring the mechanism of molting.

A high-performance liquid chromatography method was developed that can detect and isolate as little as 2 ng of locust adipokinetic hormone in insect tissue - Beltsville, Maryland. The method, which utilizes state-of-the-art column technology, volatile buffers, and UV absorption at 210 nm should be widely adaptable to the isolation of a wide range of neuropeptides from invertebrate nerve tissue.

An ovarian hormone was shown to be necessary for pheromone production in house flies Fargo, North Dakota. This hormone can be mimicked by 20-hydroxyecdysone. Injections of 20-hydroxyecdysone into ovariectomized flies or into males induced synthesis of the pheromone (Z)-9-tricosene. Induction of pheromone biosynthesis, particularly in males, provides a highly specific bioassay for future studies to characterize and determine the mode of action of the ovarian hormone. It is also a model system for studying hormonal control of gene switching as involved in biosynthesis of surface hydrocarbons and pheromones (i.e., changing sex-specific hydrocarbon patterns).

Benzoylphenyl ureas were found to prevent activation of chitin synthetase zymogen - Fargo, North Dakota. A number of agricultural chemicals inhibit chitin synthesis in insects and fungi by several different pathways. The benzoylphenyl ureas are the most effective inhibitors by at least an order of magnitude, and as a result are extremely effective insecticides. This high level of activity stems from a unique mode of action that amplifies its effectiveness. The benzoylphenyl ureas were found to inhibit the action of serine protease enzymes, and in this way prevent activation of the chitin synthetase zymogen. This prevents production of the active enzyme, preventing polymerization of N-acetylglucosamine into chitin. With knowledge of the mode

of action of this compound the design of more specific and effective inhibitors is now feasible.

Storage of uric acid in fat body cells of tobacco hornworm is induced by 20-hydroxyecdysone - Fargo, North Dakota. Storage of uric acid/urate in fat body cells of the tobacco hornworm, Manduca sexta, at the onset of metamorphosis is induced by 20-hydroxyecdysone in the absence of juvenile hormone. Uric acid increases in the homolymph during pupal development because of the presence of juvenile hormone. The hemolymph urate concentration markedly decreases just before pupal ecdysis because of the degradation of the hormone by a specific esterase. The uric acid excretion/storage process in the tobacco hornworm has the potential to serve as a model system for studying ion/solute transport, membrane function, gene switching (synthesis of new proteins), and the interaction between 20-hydroxyecdysone and juvenile hormone in regulating these phenomena.

Isozyme data support the hypothesis that the northern corn rootworm consists of two species - Fargo, North Dakota. Isozymes were studied in crosses between the eastern population (Diabrotica longicornis barberi) and the western population (D. longicornis longicornis).

The modes of inheritance for allozymes of xanthine dehydrogenase (Xdh), hexokinase (Hk), malate dehydrogenase (Mdh), and an esterase (Est-m) were determined by electrophoretic analyses of specimens from intra- and intersubspecific crosses of Diabrotica longicornis longicornis (Say) and D. l. barberi Smith and Lawrence. Comparisons of P_1 and corresponding F_1 enzyme patterns provided evidence of co-dominant alleles segregating at autosomal loci for Xdh, Hk, and Mdh. A sex-limited autosomal locus was implicated in the expression of Est-m electromorphis. The data indicate that the various allozyme systems are allelic in the two subspecies.

The esterase gene-alleles are absent in D. l. barberi and the presence of the esterase appears to be diagnostic of D. l. longicornis when expressed in males. (In cooperation with Northern Grain Insects Research Laboratory, Brookings, South Dakota.)

Physiology of screwworm-infested wounds was found to be strongly affected by symbiotic Proteus bacteria - Fargo, North Dakota. Proteus species have been found in screwworm larvae and pupae as well as in various larval feeding media, including fluids from screwworm-infested animals. In more than 50 isolations from laboratory and field samples obtained in Texas, North Dakota, and Mexico, combinations of Proteus mirabilis, P. vulgaris. P. morganii, P. rettgeri and P. inconstans were detected. While not all Proteus species were found in a given sample and different ones predominated in different samples, at least one Proteus sp. was consistently present. In laboratory olfactometer tests, bacterial cultures of P. rettgeri attracted up to 80% of mated female flies, depending on the dilution of the inoculated broth. Proteus rettgeri has been isolated in pure culture from larval salivary glands, pupae, and wounds containing screwworm larvae. Preliminary electron microscopic examination

suggests that Proteus bacteria may weaken the puparium thus helping adult screwworm flies emerge.

Proteus mirabilis isolated from screwworm larvae produces bactericide - Fargo, North Dakota. Bactericidal activity was found in the filtrate of Proteus mirabilis isolated from screwworm fly larvae. The activity of this filtrate was inversely proportional to the pH. Greatest activity was found at pH 2.5, gradually decreasing until lost at pH 4.5. However, if the pH of an alkaline sample was returned to pH 2.5, the bactericidal activity resumed.

Salmonella typhimurium, Proteus mirabilis, and Staphylococcus epidermidis were found highly susceptible to the filtrate. A 1-min exposure to pH 2.5 filtrate produced a 99.98%, 99.99%, and 99.97% decrease in population respectively. Proteus rettgeri was more resistant to the filtrate since a 1-min exposure to pH 2.5 filtrate resulted in only a 12% decrease in population. (In cooperation with North Dakota State University.)

Hybrid sterility in Heliothis subflexa x H. virescens crosses was stable and probably not caused by cytoplasmic microorganisms - Fargo, North Dakota. When female Heliothis subflexa and H. virescens male are crossed, the female hybrids are fertile and the male hybrids are sterile. Continuous backcrossing of the hybrid females to H. virescens males produces fertile female and sterile male progeny (BC) idefinitely. Attempts to alter the sterility of the BC males were made by injecting the fourth to fifth instar larvae with the antiviral agents rifampin, 5-iodo-2'-deoxyuridine (IUdR), and alcide; rearing the egg, larval, and pupal stages at temperatures of 16.7, 20, 29, and 32°C; or by administering 30-min or 24-hr heat shocks (36-43°C) to either the egg, larval or pupal stages. The sterility of the BC males is extemely stable and is unaffected by treatments. These findings indicate that a cytoplasmic microorganism is probably not involved in the sterility found in these interspecific crosses. The stability of this hybrid sterility is an important attribute in its possible use in genetical control of H. virescens.

A boll weevil strain with tolerance to sexually sterilizing doses of ionizing radiation was developed through sibling selection - Fargo, North Dakota. A genetic selection experiment in the boll weevil, Anthonomus grandis Boheman, was used to evaluate the degree to which variation in postirradiation survival may be under genetic control. Ten generations of family selection for 14-day postirradiation survival increased percent survival from 35% to almost 70% and increased life expectancy following irradiation by about 4 days. Estimates of realized heritability of half-sib family means of near 0.3 were required for this magnitude of response. The results indicate that selection for genetic improvement has merit in the development of a mass rearing stock for release in a sterile insect program. (In cooperation with the University of Minesota).

Technological Objective 2: Develop new and improved principles and practices of insect control based on behavior and ecology.

Research Locations:

Albany, California
Gainesville, Florida
Beltsville, Maryland
Otis Air National Guard Base, Massachusetts
Fargo, North Dakota
Wyndmoor, Pennsylvania
Yakima, Washington

Examples of Progress:

Sex pheromone was identified and synthesized for the western grapeleaf skeletonizer - Albany, California. Females of the western grapeleaf skeletonizer, Harrisina brillians, an important pest of grapes, were found to emit sec-butyl-(Z)-7-tetradecanoate. The racemic material caused wing fluttering, hair pencil extension, and copulatory attempts. (In cooperation with Stored Products Insects Laboratory, Fresno, California.)

Compounds in alfalfa seed pods were found to be strongly attractive to the alfalfa seed chalicid - Albany, California. By means of GC-MS, 31 volatile components were identified in alfalfa seed pods, and 33 components were identified in alfalfa flowers. These components were compared to those in alfalfa leaves and stems. The pods are specifically attractive to the alfalfa seed chalcid, Bruchophagus roddi Guss. and have the largest relative amounts of (Z)-3-hexenol, 1-octen-3-ol, caryophyllene, β-farnesene, γ-murolene benzyl alcohol, and 2-phenylethanol. The flowers had the greatest relative amounts of (E)-β-ocimene, decanyl acetate, dodecanyl acetate, and neryl 2-methylbutyrate.

New concepts were developed on how the cotton plant resists insect attack - Albany, California. Feeding experiments with young bollworms on cotton foliage indicated that the insects avoid feeding on the glands and selectively feed on surrounding tissues. Because the impact of allelochemics is greater on young insects, the direct role of gossypol in cotton glands as related to cotton's resistance in bollworm may be much less than what has been assumed.

Cyanidin-3-glycoside was isolated from cotton glands indicating that the gland can produce flavonoids and tannin precursors in addition to gossypol and its derivatives.

The effects of four flavones, five flavonols, condensed tannin, and terpene aldehydes on the growth of pink bollworm larvae were investigated. The effective dosages of these compounds to reduce pink bollworm larval growth to half that in larvae fed a control diet (ED_{50}) were approximately 1 to 2 mM/kg for flavonoids with ortho dihydroxy substitutions, 0.1 for polymeric tannin, and approximately 1 to 3 for the terpene aldehydes, respectively.

The effect of dietary methyl ester of cyclopropanoid and cyclopropenoid fatty acids from the cotton plant on the growth of larvae of the pink bollworm, Pectinophora gossypiella, the bollworm, Heliothis zea and the tobacco budworm, Heliothis virescens, was investigated. The major cotton cyclopropenoid, malvalate, had an ED_{50} of 0.28% for larvae of the pink bollworm, 0.64% for larvae of the bollworm, and 0.66% for larvae of the tobacco budworm.

Cyclopropenoids at 0.5% in the diet delayed pupation of bollworm larvae and reduced percent pupation but did not affect pupal weight or viability. The fatty acid composition of larvae unable to pupate is much higher in stearic acid and lower in palmitoleic acid than that of control larvae, indicating that desaturation enzymes were inhibited.

Plant growth regulator induces resistance to greenbug in susceptible sorghum - Albany, California. Application of the plant growth regulator chlormequat chloride to seedlings of a greenbug-susceptible line of sorghum (BOK 8) caused the mature plants to be as resistant to aphids as a greenbug-resistant line (GBR 449). By contrast, mepiquat chloride increased the susceptibility of sorghum to the pest.

Sex pheromone of velvetbean caterpillar identified - Gainesville, Florida. The pheromone produced by female velvetbean caterpillar moths was isolated and identified as a mixture of two olefinic hydrocarbons, (Z,Z,Z)-3,6,9-eicosatriene and (Z,Z,Z)-3,6,9-heneicosatriene. One hundred micrograms on rubber septa captured more males in traps than did three virgin females. The optimum ratio of the pheromone components is very broad, with ratios of the C_{20} compound to the C_{21} compound of 200:800 and 600:400 capturing nearly equal numbers of males. This pheromone can now be used to monitor population buildups by this important soybean pest and possibly to study its dispersal over vast areas of the southeastern United States each spring and summer.

Southern corn rootworm sex pheromone was identified and synthesized - Gainesville, Florida. In collaborative effort with the ARS Northern Grain Insects Research Laboratory, Brookings, South Dakota, a sex pheromone produced by female southern corn rootworms was identified as 10-methyl-2-tridecanone. This compound was synthesized in its racemic and its enantiomerically pure forms. The racemic material and the (R)-enantiomer were both highly attractive to males in field trapping experiments. The accuracy of monitoring programs for this pest should be greatly increased by using this pheromone, and thus more effective control and integrated pest management programs for this pest should result.

Synthetic method for preparing asymmetric pheromones in high configurational purity developed - Gainesville, Florida. The basis of this method is to synthesize a readily prepared precursor of the pheromone and to separate it into its enantiomers by fractional crystallization. The appropriate enantiomer is then used to synthesize the pheromone. By this method, the pheromone is obtained easily, in high yield, and high configurational purity (>99%). Both enantiomers of the southern corn rootworm pheromone and of the lesser tea

tortrix pheromone have been made employing this concept. This method provides compounds to accurately assess the effect of enantiomeric purity on biological activity, and has applications for the synthesis of many asymmetric compounds. Since the activity of many pheromones depends on enantiomeric purity or composition, this development will be important in providing pheromones with optimum biological activity and in increasing our basic knowledge of insect chemical communication systems.

Bollworm sex pheromones increased parasitization by Trichogramma wasps - Gainesville, Florida. In collaborative effort with the USDA-ARS Southern Grain Insects Research Laboratory, Tifton, Georgia, Heliothis zea sex pheromone was found to dramatically increase parasitization of eggs by naturally occurring Trichogramma when black Conrel® fibers formulated with the pheromone were placed in plots of cotton in the field. This discovery emphasizes the importance of investigating the management of beneficial insects with interspecific semiochemicals and indicates that biological control methods may be greatly enhanced in some cases through the use of behavior modifying chemicals.

Control of tomato pinworm with sex pheromone shows promise - Gainesville, Florida. Evaporation of the tomato pinworm sex pheromone formulated in Celcon® hollow fibers was very effective in disrupting mating of the pest in tomato fields for up to 4 weeks. The commercial cooperator--Albany International, Controlled Release Division, Buckeye, Arizona--is considering the economic feasibility of marketing the system as a component of IPM programs in Florida and other tomato-growing areas.

Sex pheromone formulations effective for beet armyworm - Gainesville, Florida. Field tests were conducted with various blends of synthetic compounds corresponding to those identified from active pheromone fractions obtained from whole body washes and air volatiles given off by active vigorous beet armyworm females. The compounds were tested in replicated experiments in various ratios and different blends formulated on rubber septa. Captures of wild beet armyworm males were optimum when Pherocon® 1C sticky traps were baited with 0.1 mg Z9,E12-14:AC and 0.01 mg Z9-14:OH. All combinations of acetates alone captured significantly fewer males than blends containing Z9,E12-14:AC and Z9-14:OH in a 10:1 ratio. This pheromone blend can now be used to monitor beet armyworm populations in a wide variety of field and horticultural crops. Research has also demonstrated that a component of the pheromone Z9,E12-14:AC could possibly be used to control the beet armyworm in commercial floricultural crops such as chrysanthemums.

An improved trap for Caribbean fruit fly was developed and trap features most likely to increase capture of Tephritid fruit flies were identified - Gainesville, Florida. A striped fluorescent color pattern and an adhesive undersurface were found to increase trap capture of Tephritid fruit flies. The improved traps capture and retain a higher number of flies, at reduced size, cost, and operational difficulty, than standard McPhail or Rebel traps. This may provide a more effective trap for the detection of Tephritid fruit flies such as the Mediterranean and the Caribbean fruit flies.

High visual sensitivity and host association were found to be correlated in wild Caribbean fruit flies - Gainesville, Florida. Wild A. suspensa (Caribbean fruit fly) collected on host (guava) fruit and foliage were found to have significantly higher visual sensitivities than those of flies reared from field-collected pupae, indicating that high visual sensitivity is associated with, if not directly related to, host-finding and/or predator avoidance ability in the species. Hence, field performance could be predicted from electroretinographically assessed differences in visual sensitivity. This knowledge will greatly aid in the Quality Assurance Program in mass rearing facilities for sterile release programs.

Two mating strategies discovered in the Caribbean fruit fly - Gainesville, Florida. Field and field-cage studies of mating behavior of the Caribbean fruit fly revealed two male strategies: (1) searching for feeding and ovipositing females and (2) attracting females to mating territories by chemical and acoustical signals. Because most matings (87%) occur as a result of females being attracted to male aggregations (leks), male competitiveness is a criterion for mating success. Considerations of sterile release ratios and quality control must take this into account. Quality assessments must consider attributes that contribute to this competitiveness and new tests to evaluate these attributes must be developed as quality control procedures in mass-reared insects.

System of quality control for laboratory-reared Caribbean fruit flies developed - Gainesville, Florida. Several behavioral and physiological parameters for evaluating the effectiveness of flies in a release program were established. Analyses of the data have been computerized and systemized, allowing results to be easily accessible and applicable. The system can be readily adapted for any large fruit fly sterile release program for which routine evaluations of the effectiveness of the mass-produced flies are desired. The Joint Mexico/U.S. Medfly Program, the California Medfly Project, and the Japanese Fruit Fly Eradication Program have adopted these procedures.

Pheromone of western bean cutworm identified and synthesized - Beltsville, Maryland. The female sex pheromone of the western bean cutworm (Loxagrotis albicosta) was identified from four adult females. The females produced a mixture of (Z)-5-dodecenyl acetate, (Z)-7-dodecenyl acetate, 11-dodecenyl acetate, and dodecyl acetate in a 3:1:3:3 proportion. Field studies using insect traps baited with various combinations of the four compounds showed that a mixture of the three olefinic acetates is the minimum set of compounds required for maximal trap capture of adult males and that a rubber septum impregnated with 198 µg of a mixture of the three olefinic acetates was more effective in causing male capture than one virgin female western bean cutworm.

Optical configuration of bagworm pheromone determined - Beltsville, Maryland. The pheromone of the bagworm, Thyridopteryx ephemeraeformis (Haworth), was evaluated in a field test and shown to be highly attractive to male bagworm moths. The pheromone, 2-pentyl decanoate, is the only compound in a series of homologous esters that is attractive. The two enantiomers, (+) and (-), of this optically active compound were synthesized and only the (-)-2-pentyl decanoate

was active; addition of the (+) antipode in the racemic mixture did not alter the attractiveness of the (-) compound. To prove the optical configuration of the natural pheromone, 2-pentanol was generated from the ester and then derivatized; it was shown to have the (-) configuration.

Preliminary field tests with the bagworm pheromone formulated in Hercon laminate showed that the compound can be effectively used to suppress mating. In the tests, females on trees that have been treated with pheromone went unmated whereas females on control trees were mated.

Gas chromatography-mass spectroscopy procedure developed for identification of double-bond position in long-chain alcohols and acetates - Beltsville, Maryland. The development of a reaction GC-MS procedure for the identification of the carbon-skeleton of terpene-type alcohols has been completed. The method was modified to make it applicable to esters.

A GC-MS procedure was developed for the identification of the double-bond position in nanogram quantities of long-chain alcohols and acetates; no derivatization is required.

Feeding deterrent extracted from seed of the sugar-apple (Annona squamosa) - Beltsville, Maryland. This plant was found to contain several fractions with effective antifeedant activity against the larvae of the fall armyworm, Spodoptera frugipera. In addition, some fractions, when applied topically, were toxic to nymphs of the large milkweed bug.

Tetrahydropyranyl ethers of 3,4-dimethoxyphenol and of 3,4,5-trimethoxyphenol were found to deter feeding by the striped cucumber beetle - Beltsville, Maryland.

Structure of hair pencil pheromone determined for tobacco budworm - Beltsville, Maryland. During courtship, Heliothis virescens males were found to release (Z)-9-tetradecenal. The activity of this compound was confirmed by electro-antennography.

Components of Mexican fruit fly male pheromone identified - Beltsville, Maryland. Male Anastrepha ludens were found to emit (Z)-3-nonen-1-ol, (Z,Z)-3,6-nonadien-1-ol, and two γ-lactones.

Pyridine enhances attractiveness of fermented lure to Mexican fruit flies - Beltsville, Maryland. The attractant presently used to survey citrus areas for Mexican fruit fly is a multicomponent protein hydrolysate mixture. Field trapping studies conducted in Mexico showed that addition of a small amount of pyridine to the mixture considerably enhances its attractiveness for both sexes of the fly, although pyridine possesses no attraction per se.

New medfly attractants discovered in plants - Beltsville, Maryland. An ether extract of leaves and fruits of Trichilia maynasiana from Peru was found to be attractive to male Mediterranean fruit flies, and an ether extract of leaves of

Piptocarpha chontalensis from Costa Rica was attractive to female Mediterranean fruit flies and melon flies.

Color perception by face flies found to depend on sex - Beltsville, Maryland. Adult male face flies are attracted to green light similar to that reflected by the leaves of trees and plants on which they spend much of their day; adult females are not attracted to this light, but strongly prefer the ultra violet light such as might be reflected from the faces of cattle.

American dog tick is more than a seasonal pest in Maryland - Beltsville, Maryland. The primary vector of Rocky Mountain spotted fewer in Maryland, the American dog tick, Dermacentor variabilis Say. was found on rodents trapped at the Patuxent National Wildlife Refuge every month of the year. This information explains the occasional case of Rocky Mountain spotted fever in October, November, and December, months when the tick was thought to be inactive.

Diapause (hibernation) induced in face flies - Beltsville, Maryland. Over 80% of a population of newly emerged face flies of the Beltsville strain entered diapause when exposed for over 5 days to 12-hr light and 12-hr dark and a day-night temperature of 21°-16°C respectively. This is important because biochemical and behavioral research in the laboratory and field depends upon production of insects in which the diapause (hibernation) potential can be predicted precisely.

Qualitative differences were found in gypsy moths from high-density and low-density populations - Otis ANGB, Massachusetts. In samples of insects from western Massachusetts, gypsy moths from the high population density area had lower egg mass and individual egg weights, higher incidence of viruses, slower rate of egg hatch, slower development and reduced survival of the immature stages. Population quality differences were best revealed when eggs, instead of larvae, were placed on diet presumably because of reduced bias in sampling.

Efficacy of gypsy moth nuclear polyhedrosis virus was increased by strain selection and by boric acid - Otis ANGB, Massachusetts. Nineteen virus isolates from North America, Europe, and Asia were screened for biological activity against the gypsy moth. Four isolates from Massachusetts and Canada were found to be up to five times more active than the standard Hamden isolate that is currently used for virus production. Further increase in biological activity was obtained in the laboratory through selection within individual isolates for increased virulence. After four passages, a virus isolate was obtained with increased tolerance to ultraviolet light. This study will be continued until ten successive exposures to ultraviolet light and passages have been made. Freeze-dried plant extracts as well as various purified chemicals in combination with the virus were tested for enhanced virulence. Addition of boric acid or sodium borate (1%) enhanced virus-induced mortality about ten times in laboratory tests of moth larvae reared on artificial diet or red oak foliage.

Temperature-labile substance postulated to cause diapause in gypsy moth by preventing secretion of development-promoting neurohormones - Otis ANGB, Massachusetts. When eggs are incubated at 25°C, diapause (determined by measuring the daily changes in weight) occurred at 14 days after oviposition. A selected non-diapausing (NDP) stock showed a considerable decrease in metabolism between days 14 and 16 after oviposition. After this time the NDP stock underwent an abrupt increase in metabolism whereas DP eggs showed continued low metabolism. Data suggest that diapause results from a temperature-labile substance that prevents the secretion of development-promoting neurohormones. Low temperatures inactivate the inhibitory factor.

Undescribed pyemotid mite species is natural enemy of sunflower stem weevils - Fargo, North Dakota. A pyemotid mite found infesting sunflower stem weevils in North Dakota was also found on larvae in sunflower stems shipped from Texas. An efficient rearing procedure was developed for laboratory maintenance on stem weevil larvae or by forced acceptance of other available insects reared in the laboratory. Experiments with about 20 other insect species, including some closely related to the stem weevil, Cylindrocopturus adspersus, or associated with sunflowers, indicate that this mite is effectively host specific to the stem weevil and is apparently a new species of mite. The mite is innocuous to humans and can be easily maintained without danger of infesting other insect colonies.

Technological Objective 3: Develop new principles and practices in insecticide use.

Research Locations:

Beltsville, Maryland
Yakima, Washington

Examples of Progress:

Fifty-three new candidate chemicals for insect control were submitted for research evaluation - Beltsville, Maryland. Evaluation procedures were begun for 29 organophosphates and carbamates, 7 hydrazones, 5 pyrethroids, 5 heterocycles, and 7 miscellaneous types submitted by industrial laboratories.

Pesticide research data computerized - Beltsville, Maryland. About 5000 additional chemical records were entered through Prime and linked with their Chemical Abstracts registry numbers for access to other data bases. In this manner more than one-fourth of chemicals that have been evaluated against insects are now identified. In addition, eight search requests were satisfactorily completed on the Nash environmental dissipation file.

Structure activity assessments now possible with chemical abstracts registry system - Beltsville, Maryland. CAS Online was installed for trial searches of the Chemical Abstracts registry system (5.5 million structures since 1964) for structures related to known biologically active compounds. Wiswesser line notations (WLNs) were sorted by significant features by means of Prime.

Residues of ethylene dibromide in treated grapefruit below detection limits after 3 weeks' aeration - Beltsville, Maryland. Initial results from a collaborative study of the behavior of ethylene dibromide residues in wheat, flour, bread, and citrus (grapefruit) showed that, although initial grapefruit residues levels after fumigation were 2.7 to 24.1 ppm, the levels fell rapidly, and the residues were nondetectable after 3 weeks.

Residues of insect growth regulators were much more stable than organophosphorus insecticides in mushroom compost - Beltsville, Maryland. Data on the stability of potential fly-control chemicals in mushroom compost obtained in a collaborative project with the Vegetable Laboratory, Beltsville, showed that three ureide insect growth regulators (diflubenzuron, BAY SIR 8514, and Lilly 7063) were much more stable than diazinon, ethoprop, or chlorpyrifos. Chemical analyses were supported by bioassays with a sciarid fly. These results are encouraging as a basis for further investigations and the development of effective fly control in the commercial mushroom industry.

Disposable water-adsorbent extraction columns can replace liquid-liquid extraction as cleanup step in residue analysis - Beltsville, Maryland. Tests conducted in connection with the development of a method of analysis for residues of an insect growth regulator in milk showed that commercially available 300-ml disposable extraction columns containing a proprietory

hydrophilic packing can replace the liquid-liquid partition step for samples high in water content, such as milk. This is probably the first application of these columns to residue analysis.

Pyrethroids found to react with amino acids at baking temperatures - Beltsville, Maryland. Analysis of the reaction products created from the treatment of three selected pyrethroids with a large excess of glycine or wheat gliadin and baked for 3 hours revealed the presence of unreacted pyrethroid, unreacted amino acid or protein, and pyrethroid-amino acid decomposition products. Similar results were obtained when the reaction was run on a solid matrix.

d-Phenothrin dust was effective for disinsection of aircraft - Beltsville, Maryland. d-Phenothrin formulated as a 30% dust in silica gel or diatomaceous earth and disseminated in a 2000 to 3000 cu ft chamber at 2.1 g active ingredient per cubic meter was toxic to 100% of Heliothis virescens, Musca domestica, Anopheles quadrimaculatus, Aedes taeniorhynchus, Anthonomus grandis, Rhipicephalus sanguineus, Blattella germanica, Blatta orientalis, and Popillia japonica.

Recommended uses do not leave harmful residues of systemic insecticides in the leafcutter bee environment - Yakima, Washington. Leafcutter bees, necessary for pollination of alfalfa grown for seed in the Pacific Northwest, have experienced a lack of vigor and high mortality in recent years. In a program designed to determine if systemic insecticides could be involved, residues of all systemic insecticides tested were found in bee cells. However, the residue levels found were below previously determined harmful levels.

Aldicarb in crop residue found to contaminate subsequent crops - Yakima, Washington. Because of its low persistence in soil, this widely used broad spectrum insecticide was not previously thought to be persistent enough to be carried over from one crop year to the next. However, crop contamination did result from crop rotation. The aldicarb persists in crop foliage, which when plowed back into the soil leads to residues in crops planted the next year. The foliage of the following crops have been shown to produce this effect: potato, alfalfa, mint, mustard greens, and radish.

Exposure of agricultural workers to 2,4-D found to be largely preventable - Yakima, Washington. The greatest dermal exposure of mix-loaders, applicators, and bystanders of ground and aerial applications is to the hands. It was found that 90 to 100% of the dermal exposure can be eliminated by wearing gloves, and more importantly, that levels of 2,4-D in urine and perspiration can be lowered to the same degree when gloves are worn. This not only established the efficacy of gloves for lowering worker exposure, but demonstrates that worker exposure is virtually 100% dermal and exposure by inhalation is not a significant factor.

PUBLICATIONS

Albany, California

Buttery, R. G., F. D. Parker, R. Teranishi, T. R. Mon, and L. C. Ling. 1981. Volatile components of alfalfa leafcutter bee cells. J. Agric. Food Chem. 29: 955-958.

Buttery, R. G., E. L. Soderstrom, R. M. Seifert, A. P. Yerington, and L. C. Ling. 1981. Raisin and dried fig volatile components: Possible insect attractants. In R. Teranishi and H. Barrera-Benitez (Eds.), ACS Symposium Series No. 170, Quality of Selected Fruits and Vegetables in North America. American Chemical Society, Washington, D.C.

Chan, B. G. and A. C. Waiss, Jr. 1981. Evidence for acetogenic and shikimic pathways in cotton glands. In Proc. of Beltwide Cotton Production Research Conference, Jan. 4-8, 1981, New Orleans, LA., 49-51.

Dreyer, D. L. and K. C. Jones. 1981. Feeding deterrency of flavonoids and related phenolics toward Schizaphis graminum and Myzus persicae. Aphid feeding deterrents in wheat. Phytochemistry 20:2489.

Dreyer, D. L., J. C. Reese, and K. C. Jones. 1981. Aphid feeding deterrents in sorghum, bioassay, isolation and characterization. J. Chem. Ecol. 7:273.

Elliger, C. A., R. E. Lundin, and W. F. Haddon. 1981. Caffeyl esters of glutaric acid in Lycopersicon esculentum leaves. Phytochemistry 20(5): 1133-1134.

Elliger, C. A., Y. Wong, B. G. Chan, and A. C. Waiss, Jr. 1981. Growth inhibitors in tomato (Lycopersicon) to tomato fruit worm (Heliothis zea). J. Chem. Ecol. 7:753-758.

Reese, J. C., B. G. Chan, N. R. Malm, and A. C. Waiss, Jr. 1981. Feeding sites of bollworm larvae on cotton. Envir. Entomol. 10:81-84.

Waiss, A. C. Jr., B. G. Chan, C. A. Elliger, D. L. Dreyer, R. G. Binder, and R. G. Gueldner. 1981. Insect growth inhibitors in crop plants. Bull. Entomol. Soc. Amer. 27:217-221.

Gainesville, Florida

Ashley, T. R. 1981. FAMULUS: A reprint classification system for the research scientist. Bull. Entomol. Soc. Amer. 27:161-165.

Boller, E. F., B. I. Katsoyannos, U. Remund, and D. L. Chambers. 1981. Measuring, monitoring and improving the quality of mass-reared Mediterranean fruit flies, Ceratitis capitata Wied. I. The RAPID quality control system for early warning. Z. angew. Entomol. 92:67-83.

Callahan, P. S. 1981. Nonlinear IR resonance in biological systems. Appl. Optics 20(22):3827-3828.

Callahan, P. S. 1981. John Tyndall--Contributions to the development of infrared and solid state communications, pp. 129-144. In W. H. Brock, N. D. McMillan, and R. C. Mollan (Eds.) John Tyndall Essays on the Natural Philosopher. Royal Dublin Soc.

Chambers, D. L. 1981. Forward. In R. Mitchell (Ed.), Management of Insect Pests with Semiochemicals: Concepts and Practices. Plenum Press, New York.

Doolittle, R. E. 1981. The stereoselectivity of the reduction of homopropargylic alcohols to homallylic alcohols. Org. Prep. Proced. Int. 13:179-184.

Ferkovich, S. M., H. Oberlander, and C. E. Leach. 1981. Chitin synthesis in larval and pupal epidermis of the Indian meal moth, Plodia interpunctella (Hubner), and the greater wax moth, Galleria mellonella. J. Insect Physiol. 27:509-514.

Greany, P. D. 1981. Culture of hymenopteran endoparasites in vitro. In Vitro 17:230.

Greany, P. D. and K. S. Hagen. 1981. Prey selection, pp. 121-126. In D. A. Nordlund, R. L. Jones, and W. J. Lewis (Eds.), Semiochemicals: Their Role in Pest Control. John Wiley & Sons, New York, 306 pp.

Greenfield, M. D. 1981. Book review of "Sexual Selection and Reproductive Competition in Insects." Entom. Soc. Bull. 27(3):229-230.

Heath, R. R., J. R. Jordan, and P. E. Sonnet. 1981. Effects of film thickness and supercooling on the performance of cholesteryl cinnamate liquid crystal capillary columns. J. High Resolution Chromatogr. and Chromatogr. Communication 4:328-332.

Johnson, D. W., E. R. Mitchell, J. H. Tumlinson, and G. E. Allen. 1981. Velvetbean caterpillar: Response of males to virgin females and pheromone in the laboratory and field. Fla. Entomol. 64:528-533.

Klein, M. G., J. H. Tumlinson, T. L. Ladd, Jr., and R. E. Doolittle. 1981. Japanese beetle (Coleoptera: Scarabaeidae): Response to synthetic sex attractant plus phenethyl propionate: eugenol. J. Chem. Ecol. 7:(1):1-7.

Leppla, N. C. 1981. The Florida Entomological Club. Fla. Entomol. 64(2): 358-360.

Lynn, D. E. and H. Oberlander. 1981. The effects of cytoskeletal disrupting agents on the morphological response of a cloned Manduca sexta cell line to 20-hydroxyecdysone. Wilhelm Roux Arch. Devel. Biol. Roux's Archives 190:150-155.

Lynn, D. E. and H. Oberlander. 1981. Development of cell lines from imaginal wing discs of Lepidoptera. In Vitro 17:208.

Mayer, M. S., R. W. Mankin, and T. C. Carlysle. 1981. External antennal morphometry of Trichoplusi ni (Hubner). J. Insect Morphol. Embryol. 10:185-201.

McLaughlin, J. R., E. R. Mitchell, and J. H. Cross. 1981. Field and laboratory evaluation of mating disruptants of Heliothis zea and Spodoptera frugiperda in Florida, pp. 243-251. In E. R. Mitchell (Ed.), Management of Insect Pests with Semiochemicals: Concepts and Practice. Plenum Press, New York.

Miller, S. G. and H. Oberlander. 1981. Identification of newly synthesized wing imaginal disc proteins induced by 20-hydroxyecdysone in Galleria mellonella. In Vitro 17:689-694.

Mitchell, E. R. (Ed.). 1981. Management of Insect Pests with Semiochemicals: Concepts and Practice. Plenum Press, New York.

Mitchell, E. R. 1980. Book review of "New Technology of Pest Control," C. B. Huffaker (Ed.). Qu. Rev. Biol. 56:226.

Mitchell, E. R. and H. R. Agee. 1981. Response of beet and fall armyworm moths to different colored lamps in the laboratory and field. J. Environ. Sci. Health A16(4):387-396.

Oberlander, H. 1981. Book review of "Neurohormonal Techniques in Insects (1980)," T. A. Miller (Ed.). Fla. Entomol. 64(2):379-380.

Oberlander, H., C. E. Leach, and D. E. Lynn. 1981. Effects of cycloheximide on cellular elongation in a Manduca sexta cell line. Wilhelm Roux Arch. Devel. Biol. 190:60-61.

Rabson, M. S. and E. R. Mitchell. 1981. Relative efficiency of sticky and cylindrical electrical grid traps in capturing Spodoptera exigua. J. Chem. Ecol. 7:733-740.

Rabson, M. S. and E. R. Mitchell. 1981. Behavioral response of beet armyworm and males to female-produced sex pheromone. J. Environ. Sci. Health A16(2):139-147.

Rhodes, H. A., W. T. Wilson, P. E. Sonnet, and A. Stoner. 1981. Honeybees die from pollen contaminated fourteen months earlier with Penncap-M. Apic. Res. 120:577-581.

Rogoff, W. M., G. H. Gretz, P. E. Sonnet, and M. Schwarz. 1980. Responses of male house flies to muscalure and to combinations of hydrocarbons with and without muscalure. Environ. Entomol. 9:605-606.

Remund, U., A. P. Economopoulos, E. F. Boller, H. R. Agee, and J. C. Davis. 1981. Fruit fly quality monitoring: The spectral sensitivity of field-collected and laboratory-reared olive flies, Dacus oleae GMEL. (Dipt., Tephritidae). Bull. Soc. Entomol. Suisse 54:221-227.

Ruhm, M. E. and C. O. Calkins. 1981. Eye-color changes in Ceratitis capitata pupae, a technique to determine pupal development. Entomol. Exp. Appl. 29:237-240.

Sales, F. M., J. R. McLaughlin, and R. I. Sailer. 1980. Quantitative analysis of the behavior patterns of the female Trissolcus basalis (Wollaston) when stimulated by the kairomonal extract of the host, Nezra viridula (L). Fitossandade Fortaleza 4:43-50.

Taylor, T. R., S. M. Ferkovich, and F. Van Essen. 1981. Increased pheromone catabolism by antennal esterases after adult eclosion of the cabbage looper moth. Experienta 37:729-731.

Teal, P. E. A. 1981. The role of sex pheromones in the reproductive isolation of Heliothis species (Lepidoptera: Noctuidae). Ph.D. Dissertation, University of Florida.

Teal, P. E. A., R. R. Heath, J. H. Tumlinson, and J. R. McLaughlin. 1981. Identification of a sex pheromone of Heliothis subflexa (GN.) (Lepidoptera: Noctuidae) and field trapping studies using different blends of components. J. Chem. Ecol. 7:1011-1022.

Teal, P. E. A., R. R. Heath, J. H. Tumlinson, and J. R. McLaughlin. 1981. Isolation of a sex pheromone of Heliothis subflexa (Gn) and field tests using different blends of components. J. Chem. Ecol. 7:1011-1022.

Teal, P. E. A., J. R. McLaughlin, and J. H. Tumlinson. 1981. Analysis of the reproductive behavior of Heliothis virescens (F.) (Lepidoptera: Noctuidae) under laboratory conditions. Ann. Entomol. Soc. Am. 74:324-330.

Tingle, F. C. and E. R. Mitchell. 1981. Relationships between pheromone trap catches of male tobacco budworm larval infestations and damage levels in tobacco. J. Econ. Entomol. 74:437-440.

Tumlinson, J. H., E. R. Mitchell, and P. E. Sonnet. 1981. Sex pheromone components of the beet armyworm, Spodoptera exigua. J. Environ. Sci. Health AL6:189-200.

Tumlinson, J. H., P. E. A. Teal, and R. R. Health. 1981. Chemical ethology: A holistic approach to the study of insect pheromones. pp. 19-31. In Application of Biorational Substances and Natural Enemies. Proceedings of the First Japan/USA Symposium on Integrated Pest Management. Tsukuba, Japan.

Webb, J. C., H. R. Agee, N. C. Leppla, and C. O. Calkins. 1981. Monitoring insect quality. Trans. ASAE 2:476-479.

Beltsville, Maryland

Aldrich, J. R., J. A. Svoboda, and M. J. Thompson. 1981. Cuticle synthesis and inhibition of vitellogensis: Makisterone A is more active than 20-hydroxy-ecdysone in female milkweed bugs. J. Exp. Zool. 218:133-137.

Argauer, R. J. 1981. Disposal of non-radioactive hazardous waste chemicals at the Beltsville Agricultural Research Center. (technical/administrative report).

Argauer, R. J. 1981. Fluorescence: A chemical means of measuring the rapid loss of trace amounts of terramycin in honey from medicated colonies. Proc. of 37th Ann. Meet. American Beekeeping Federation, Seattle, Wash., Jan. 20-23, 1981.

Argauer, R. J. and W. W. Cantelo. 1981. Stability of three ureide insect chitin-synthesis inhibitors in mushroom compost determined by chemical and bioassay techniques. Mushroom News 29(8):7, 9, 11, and 12.

Baldwin, K. A., J. Bitman, M. J. Thompson, and W. E. Robbins. 1981. Effects of primary, secondary and tertiary amines on in vitro cellulose digestion and volatile fatty acid production by ruminal microorganisms. J. Anim. Sci. 53:226-230.

Banks, L. A. and M. Schwarz. 1980. The effects of insect growth regulators on laboratory and field colonies of red imported fire ants. Proc. of Tall Timbers Conference on Imported Fire Ants., Talahassee, Fla.

Bierl-Leonhardt, B. A. and E. D. DeVilbiss. 1981. Structure identification of terpene-type alcohols at microgram levels. Anal. Chem. 53(6):936-938.

Bierl-Leonhardt, B. A., D. S. Moreno, M. Schwarz, J. Fargerlund, and J. R. Plimmer. 1981. Isolation, identification and synthesis of the sex pheromone of the citrus mealybug, Planococcus citri (Risso). Tetrahedron Lett. 2:289-392.

Bitman, J., D. L. Wood, and J. M. Ruth. 1981. Two-stage, one-dimensional thin layer chromatographic method for separation of lipid classes. J. Liq. Chromatogr. 4(6):1007-1021.

Borkovec, A. B. 1981. Insect reproduction suppression by inhibitors of chitin synthesis. In W. H. Clark, Jr. and T. S. Adams (Eds.) Advances in Invertebrate Reproduction. Elsevier North-Holland, New York, p. 346.

Borkovec, A. B. and S. C. Saxena. 1981. Chemical regulation of production in insect pest management. Pestology 5(7):27-29.

Caro, J. H., H. P. Freeman, D. I. Brower, and B. A. Bierl-Leonhardt. 1981. Comparative distribution and persistence of disparlure in woodland air after aerial application of three controlled-release formulations. J. Chem. Ecol. 7(5):867-880.

Carroll, J. F., J. W. Kimbrough, and W. H. Whitcomb. 1981. Mycophagy by Aphaenagaster spp. (Hymenoptera: Formicdae). Proc. Entomol. Soc. Wash. 83(2):326-331.

Chawla, R. P. and A. K. Kakkar. 1981. Evaluation of residues of six recommended insecticides on cotton. J. Food Sci. Technol., July-August, 152-155.

Cawley, B., J. Carroll, K. Staker, D. Hayes, B. Weinland, J. Fons, S. Wood, and N. Klagg. 1981. Candidate pesticide formulations for quarantine use. Insect. Acar. Tests 6:187.

Cecil, H. C., J. Bitman, J. A. Svoboda, and M. J. Thompson. 1981. Effects of branched and straight chain amines and azasteroids on blood and egg cholesterol of white leghorn chickens. Poult. Sci. 60:795-804.

DeMilo, A. B., A. B. Borkovec, C. F. Cohen, and W. E. Robbins. 1981. Larvicidal effects of substituted diamino- and triamino-s-triazines. J. Agric. Food Chem. 29:82-84.

DeMilo, A. B., T. J. Kelly, A. B. Borkovec, and R. E. Redfern. 1981. 2-Acetylpyridine thiosemicarbazones. A new class of molt inhibitors of the large milkweed bug. 182nd Natl. Meet. American Chemical Society, New York, August 1981. Abstracts, PEST 57.

Feldmesser, J., H. Jaffe, P. A. Giang, and G. Wolfhard. 1981. Experimental controlled release formulations of a nematicidal amine. Proc. 8th Int. Symp. on Controlled Release of Bioactive Materials, July 1981, Ft. Lauderdale, Fla., 147-148.

Fons, J., B. M. Cawley, and D. K. Hayes. 1981. Evaluation of aerosols for quarantine control of three tephritid flies, 1979. Insect. and Acar. Tests 6:180.

Gentry, C. R., B. A. Bierl-Leonhardt, J. R. McLaughlin, and J. R. Plimmer. 1981. Air permeation tests with (Z,Z)-3,13-octadecadien-1-ol acetate for reduction in trap catch of peachtree and lesser peachtree borer moths. J. Chem. Ecol. 7(3):575-582.

Gilliam, M. and R. J. Argauer. 1981. Oxytetracycline residues in surplus honey, brood nest honey, and larvae after medication of colonies of honey bees, Apis mellifera, with antibiotic extender patties, sugar dusts, and syrup sprays. Environ. Entomol. 10:479-482.

Gilliam, M. and R. J. Argauer. 1981. Terramycin residues in surplus and brood nest honey after medication of honey bee colonies by three different methods. Glean. Bee Cult. 109(10):445-446, 550-551.

Gillenwater, H. G., T. P. McGovern, and L. L. McDonald. 1981. Repellents for adult Tribolium confusum: Alkynyl mandelates. J. Ga. Entomol. Soc. 16(1):106-112.

Hayes, D. K., F. Halberg, G. Cornelissen, and J. H. Stebbings. 1981. Chronobiologic concepts and biomathematical methods applicable to design and analyses of time-series studies of human health. Summary of Conference Presentations, April 1981, Alexandria, Va. Environmetrics 81: 318-319.

Hayes, D. K., F. Halberg, J. Halberg, Y. Chiba, E. Halberg, F. Carendente, and G. Cornelissen. 1981. Comparative physiology of schedule-shifting in the face fly, Musca autumnalis, and codling moth, Laspeyresia pomonella, in broader context including rodents and human beings. Int. J. Chronobiol. 7:59.

Haynes, K. F., M. C. Birch, and J. A. Klun. 1981. Sex pheromone offers promise for control of artichoke plume moth. Calif. Agric. 35(1-2):13-14.

Herbert, E. W. Jr., J. A. Svoboda, M. J. Thompson, and H. Shimanuki. 1981. Sterol requirements for brood rearing by honey bees fed a synthetic diet. Amer. Bee J. 121:523.

Hill, K. R. 1981. Monographs or monograph addenda on decamethrin, sec-butylamine, fenamiphos, and quazatine in pesticide residues in food - 1980. FAO Plant Protection and Protection Paper, #26 Sup., Rome, Italy. Also sections of Pesticide Residues in Food - 1980. Report 1980. Ibid.

Inscoe, M. N. and J. R. Plimmer. 1981. Chemistry of isolation, identification and synthesis. In The Gypsy Moth: Research Toward Integrated Pest Management, USDA Tech. Bull. 1584, 533-536.

Jacobson, M. 1981. Antifeedant for boll weevils. U.S. Patent 4,293,567, 7 pp. (October 6, 1981).

Jacobson, M. 1981. Isolation and identification of insect antifeedants and growth inhibitors from plants: An overview. pp. 13-19. In H. Schmutterer, R. S. Ascher, and H. Rembold (Eds.), Proc. First Intl. Neem Conf., Rottach-Egern, FRG, June 16-18, 1980. German Agency for Technical Cooperation, Rossdorf.

Jacobson, M. 1981. Neem research in the U.S. Department of Agriculture: Chemical, biological, and cultural aspects. pp. 33-42. In H. Schmutterer, R. S. Ascher, and H. Rembold (Eds.), Proc. First Intl. Neem Conf., Rottach-Egern, FRG, June 16-18, 1980. German Agency for Technical Cooperation, Rossdorf.

Jacobson, M., M. M. Crystal, and R. Kleiman. 1981. Effectiveness of several polyunsaturated seed oils as boll weevil feeding deterrents. J. Amer. Oil Chem. Soc. 58:982-983.

Jacobson, M., M. M. Crystal, and J. D. Warthen, Jr. 1981. Boll weevil feeding deterrents from tung oil. J. Agric. Food Chem. 29:591-593.

Jaffe, H. 1981. Microencapsulation process. 1981. U.S. Patent 4,272,398 (July 9, 1981).

Jaffe, H., P. A. Giang, D. K. Hayes, J. A. Miller, and B. H. Stroud. 1981. Implantable systems for delivery of insect growth regulators to livestock. pp. 303-310. In D. H. Lewis (Ed.), Controlled Release of Pesticides and Pharmaceuticals. Plenum, New York.

Jones, J. C. and E. Brandt. 1981. Fluid excretion by adult Aedes aegypti mosquitoes. J. Insect Physiol. 27(5):545-549.

Kalra, R. L. and R. P. Chawla. 1981. Occurrence of DDT and BHC residues in human milk in India. Experientia 37:404-405.

Kapoor, S. K, R. P. Chawla, and R. L. Kalra. 1980. Contamination of bovine milk with DDT and HCH residues in relation to their usage in malaria control programme. J. Environ. Sci. Health B15(5):545-557.

Kapoor, S. K., R. P. Chawla, and R. L. Kalra. 1981. Simplified method for the estimation of DDT and HCH residues in milk. J. Assoc. Off. Anal. Chem. 64(1):14-15.

Keiser, I., M. Jacobson, and J. A. Silva. 1981. Optimal formulations with phantolid for extending the duration of effectiveness of trimedlure and methyl (E)-6-nonenoate as attractants to male Mediterranean fruit flies. pp. 245-257. In D. H. Lewis (Ed.), Controlled Release of Pesticides and Phermaceuticals. Plenum, New York.

Keiser, I. and N. Wakabayashi. 1981. Fermentation per se as a biological slow delivery mechanism for releasing cofactors of fruit fly attractants. pp. 295-301. In D. H. Lewis (Ed.), Controlled Release of Pesticides and Pharmaceuticals. Plenum, New York.

Kelly, T. J., M. S. Fuchs, and S-H. Kang. 1981. Induction of ovarian development in autogenous Aedes atropalpus by juvenile hormone and 20-hydroxyecdysone. Int. J. Invert. Repro. 3:101-112.

Kelly, T. J., C. W. Woods, R. E. Redfern, and A. B. Borkovec. 1981. Makisterone A: The molting hormone of larval Oncopeltus? J. Exp. Zool. 218(2):127-132.

Kochansky, J. P., J. Feldmesser, and W. E. Robbins. 1981. Control of nematodes and other helminths. U.S. Patent No. 4,273,768, June 16, 1981.

Klun, J. A., K. F. Haynes, B. A. Bierl-Leonhardt, M. C. Birch, and J. R. Plimmer. 1981. Sex pheromone of the female artichoke plume moth, Platyptilia carduidactyla. Environ. Entomol: 10(5):763-765.

Lacey, L. A., C. E. Schreck, and T. P. McGovern. 1981. Native and experimental repellents against black flies (Diptera:Simuliidae) in the Amazon Basin of Brazil. Mosquito News 41(2):367-379.

Ladd, T. L. and T. P. McGovern. 1980. Japanese beetle: A superior attractant, Phenethyl Propionate + Eugenol + Geraniol, 3:7:3. J. Econ. Entomol. 73(5):689-691.

Langley, P. A., P. M. Huyton, D. A. Carlson, and M. Schwarz. 1981. Effects of Glossina morsitans morsitans Westwood (Diptera:Glossinidae) sex pheromone on behaviour of males in field and laboratory. Bull. Entomol. Res. 71:57-63.

Loeb, M. J. and M. J. Birnbaum. 1981. The relationship of hemolymph osmotic pressure to spermatogenesis in the tobacco budworm, Heliothis virescens. Int. J. Invert. Reprod. 4:67-79.

Loeb, M. J. and D. K. Hayes. 1981. Heliothis virescens: Sensitivity of larvae to pyridoxine deficiency. Ann. Entomol. Soc. Amer. 74(6):623-625.

Loeb, M. J. and D. K. Hayes. 1981. Strobilation in the Chesapeake Bay sea nettle, Chrysaora quinquecirrha. V. Neurons and neurosecretion. Trans. Amer. Micros. Soc. 100(3):264-270.

McGovern, T. P. and T. L. Ladd, Jr. 1981. Japanese beetle: New synthetic attractants. J. Econ. Entomol. 74(2):194-196.

McGovern, T. P. and C. E. Schreck. 1981. Insect repellents. U.S. Patent No. 4264594.

McGovern, T. P. and C. E. Schreck. 1981. Alicyclic piperidine derivatives as insect repellents. U.S. Patent No. 4291041.

McGovern, T. P. and C. E. Schreck. 1981. Insect repellents. U.S. Patent No. 4298612.

Meisner, J., K. R. S. Ascher, R. Aly, and J. D. Warthen, Jr. 1981. Response of Spodoptera littoralis Boisd. and Earias insulana Boisd. larvae to azadirachtin and salannin. Phytoparasitica 9:27-32.

Miller, R. W., C. Corley, C. F. Cohen, W. E. Robbins, and E. P. Marks. 1981. CGA-19255 and CGA-72662: Efficacy against flies and possible mode of action and metabolism. Southwest. Entomol. 6:272-278.

Morgan, N. O. 1981. Drum trap captures saltmarsh greenheads. Southwest. Entomol. 6(4):331-334.

Morgan. N. O. 1981. Potential impact of alien arthropod pests and vectors of animal diseases on the U.S. livestock industry. pp. 129-135. Handbook of Pest Management in Agriculture, Vol. I. CRC Press Inc., Boca Raton, Fla.

Morgan, N. O. and H. J. Retzer. 1981. Aerosol wind tunnel for vector insecticide evaluation. J. Econ. Entomol. 74(4):389-392.

Moya, G. E. B. and A. B. Borkovec. 1981. Sexual sterility of Dermatobia hominis (Linnaeus Jr.) induced by chemosterilants. Rev. Brasil. Biol. 41(4):51-56.

Osborne, E. M. and P. H. Schwartz. 1981. Insecticides and pheromones used in the Midwest: A short review. Ind. Eng. Chem. Prod. Res. Dev. 20(2):246-253.

Plimmer, J. R. 1981. Formulation and regulations: Constraints on the development of semiochemicals for insect pest management. pp. 403-420. In E. R. Mitchell (Ed.), Management of Insect Pests with Semiochemicals: Concepts and Practices. Plenum Press, New York.

Plimmer, J. R. 1981. Investigations of pheromone structure and applications to pest management. In Application of Biorational Substances and Natural Enemies: Proc. First Japan/USA Symposium on Integrated Pest Management. Tsukuba, Japan, Sept. 29-30, 1-10.

Plimmer, J. R. 1981. Pheromones of lepidoptera and their application in insect control. pp. 1035-1041. In F. Sehnal, A. Zabza, J. J. Menn, and B. Cymborowski (Eds.), Regulation of Insect Development and Behavior. Wroclaw Technical University Press, Wroclaw, Poland.

Plimmer, J. R., B. A. Bierl-Leonhardt, and M. N. Inscoe. 1981. Evolution of formulations. pp. 536-542. In The Gypsy Moth: Research Toward Integrated Pest Management, USDA Tech. Bull. 1584.

Raina, A. K. 1981. Deterrence of repeated oviposition in sorghum shootfly, Atherigona soccata. J. Chem. Ecol. 7:785-790.

Raina, A. K., R. A. Bell, and W. Klassen. 1981. Diapause in the pink bollworm: Preliminary genetic analysis. Insect Sci. Application 1(3):231-235.

Redfern, R. E., T. J. Kelly, and D. K. Hayes. 1981. Comparison of ecdysteroid concentration in and growth regulating effects on 5th-stage Oncopeltus fasciatus (Dallas) treated with four insect growth regulators. pp. 415-420. In G. E. Pratt and G. T. Brooks (Eds.), Juvenile Hormone Biochemistry. Elsevier/North-Holand Biomedical Press, Amsterdam.

Redfern, R. E., J. D. Warthen, Jr., E. C. Uebel, and G. C. Mills, Jr. 1981. The antifeedant and growth-disrupting effects of azadirachtin on Spodoptera frugiperda and Oncopeltus fasciatus. pp. 129-136. In H. Schmutterer, K. R. S. Ascher, and H. Rembold (Eds.), Proc. First Intl. Neem Conf., Rottach-Egern, FRG, June 16-18, 1980. German Agency for Technical Cooperation, Rossdorf.

Reed, D. K., M. Jacobson, J. D. Warthen, Jr., E. C. Uebel, N. J. Tromley, L. Jurd, and B. Freedman. 1981. Cucumber beetle antifeedants: Laboratory screening of natural products. USDA, SEA, Tech. Bull No. 1641, 13 pp.

Rogoff, W. M., G. H. Gretz, P. E. Sonnet, and M. Schwarz. 1981. Responses of male house flies to Muscalure and to combinations of hydrocarbons with and without Muscalure. Environ. Entomol. 9(5):605-606.

Schruft, G., E. Lehmann, B. Bierl-Leonhardt, and H. Arn. 1981. Versuche zur Orientierungsunterbrechung (Eupoecilia ambiguella Hb.) mit Pheromon-Bandern. Wein-Wisse. 36(4):268-279.

Schwartz, P. H. and W. Klassen. 1981. Estimate of losses caused by insects and mites to agricultural crops. Vol. 1, pp. 15-77. In D. Pimentel (Ed.), CRC Handbook of Pest Management in Agriculture. Boca Raton, Fla.

Schwarz, M. 1981. Book review of "Pesticide Manufacturing and Toxic Materials Control Encyclopedia," M. Sittig, (Ed.). Bull Entomol. Soc. Amer. 27(3): 232-233.

Schwarz, M., W. A. Banks, and R. W. Miller. 1981. Current research with AI3-36206 (MV678) in USDA. pp. 749-758. In F. Sehnal, et al. (Eds.), Regulation of Insect Development and Behavior. Wroclaw Technical University Press, Wroclaw, Poland.

Stokes J. B., A. B. Borkovec, and C. W. Woods. 1981. Uptake and distribution of ^{14}C-tepa in boar spermatozoa after in vitro treatment. Agric. Res. Results, ARR-NE-21, 7 pp.

Stokes, J. B., C. W. Woods, and A. B. Borkovec. 1981. Acid hydrolysis of aziridinyl phosphoramides. Phosphorus Sulfur 10:139-142.

Svoboda, J. A., E. W. Herbert, Jr., M. J. Thompson, and H. Shimanuki. 1981. The fate of radiolabelled C_{28} and C_{29} phytosterols in the honey bee. J. Insect Physiol. 27:183-188.

Svoboda, J. A. and M. J. Thompson. 1981. Ecdysteroids and inhibitors: Compounds that disrupt the molting cycle of insects and other pests of agriculture. Proc. of the First Japan/USA Symp. on IPM, Tsukuba, Japan, 50-59.

Svoboda, J. A. and M. J. Thompson. 1981. The utilization and metabolism of dietary sterols in the honey bee and the yellow fever mosquito. J. Amer. Oil Chem. Soc. 58:586A.

Teshima, S., G. W. Patterson, and S. R. Dutky. 1981. Sterols of the oyster, Crassostrea virginica. Lipids 15:1004-1011.

Thompson, M. J., B. M. Glancey, W. E. Robbins, C. S. Lofgren, S. R. Dutky, J. P. Kochansky, R. K. Vandermeer, and A. R. Glover. 1981. Major hydrocarbons of the post-pharyngeal glands of mated queens of the red imported fire ant Solenopsis invicta. Lipids 16:485-495.

Thompson, M. J., J. N. Kaplanis, G. F. Weirich, J. A. Svoboda, and W. E. Robbins. 1981. Moulting hormones of the tobacco hornworm. Intl. Conf. on Regulation of Insect Development and Behaviour. Karpacz, Poland, 107-124.

Thompson, M. J., N. B. Mandava, W. J. Meudt, W. R. Lusby, and D. W. Spaulding. 1981. Synthesis and biological activity of brassinolide and its 22β,23β-isomer: Novel plant growth-promoting steroids. Steroids 38:567-580.

Thompson, R. H., G. Patterson, M. J. Thompson, and H. T. Slover. 1981. Separation of pairs of C-24 epimeric sterols by glass capillary gas liquid chromatography. Lipids 16:694-699.

Warthen, J. D., Jr. and E. C. Uebel. 1981. Effect of azadirachtin on house crickets, Acheta domesticus. pp. 137-148. In H. Schmutterer, K. R. S. Ascher, and H. Rembold (Eds.), Proc. First Intl. Neem Conf., Rottach-Egern, FRG, June 16-18, 1980. German Agency for Technical Cooperation, Rossdorf.

Warthen, J. D., Jr., E. C. Uebel, W. R. Lusby, and V. E. Adler. 1981. The cuticular lipids of the walkingstick, Diapheromera femorata (Say). Insect Biochem. 11:467-472.

Webb, R. E., C. W. McComb, J. R. Plimmer, B. A. Bierl-Leonhardt, C. P. Schwalbe, and R. M. Altman. 1981. Disruption along the "Leading Edge" of the infestation. pp. 560-570. In C. C. Doane and M. L. McManus (Eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Otis ANGB, Massachusetts

Bell, R. A., C. Owens, M. Shapiro, and J. G. R. Tardif. 1981. Development of mass rearing technology. Chapter 6.5, pp. 599-655. In C. C. Doane, M. L. McManus (Eds.), The Gypsy Moth: Research Towards Integrated Pest Management. USDA Tech. Bull No. 1584.

Poinar, G. O., Jr., M. Shapiro, and J. E. Lindegren. 1981. Susceptibility of the gypsy moth (Lymantria dispar) to the parasitic nematode, Neoaplectana carpocapsae. IRCS Med. Sci. 9:985.

Shapiro, M. and R. A. Bell. 1981. Biological activity of Lymantria dispar nucleopolyhedrosis virus from living and virus killed larvae. Ann. Entomol. Soc. Amer. 74(1):27-28.

Shapiro, M., R. A. Bell, and C. D. Owens. 1981. Evaluation of various artificial diets for in vivo production of the gypsy moth nucleopolyhedrosis virus. J. Econom. Entomol. 74:110-111.

Shapiro, M., C. D. Owens, R. A. Bell, and H. A. Wood. 1981. Simplified, efficient system for in vivo mass production of gypsy moth nucleopolyhedrosis virus. J. Econom. Entomol. 74:341-343.

Fargo, North Dakota

Adams, T. S. 1981. Activation of successive ovarian gonotropic cycles by the corpus allatum in the house fly, Musca domestica (Diaptera:Miscidae). Int. J. Invert. Reprod. 3:41-48.

Baker, J. E. and D. R. Nelson. 1981. Cuticular hydrocarbons of adults of the cowpea weevil, Callosobruchus maculatus. J. Chem. Ecol. 7:175-182.

Clark, W. H. and T. S. Adams (Eds.). 1981. Advances in invertebrate reproduction. Proc. Second Intl. Symp. IJIR, Davis, California, August 27-31, 1979. Developments in Endocrinology, Vol. II, Elseiver/North Holland, 400 pp.

Coudron, T. A. and D. R. Nelson. 1981. Characterization and distribution of the hydrocarbons found in diapausing pupae tissues of the tobacco hornworm, Manduca sexta (L.). J. Lipid Res. 22:103-112.

Degrugillier, M. E. and S. G. Grosz. 1981. Effects of female accessory gland ablation on fertility of screwworms, stable flies, and face flies. Ann. Entomol. Soc. Amer. 74(2):217-221.

Dillwith, J. W., G. J. Blomquist, and D. R. Nelson. 1981. Biosynthesis of the hydrocarbon components of the sex pheromone of the house fly, Musca domestica. Insect Biochem. 11:247-253.

Dwyer, L. A., G. J. Blomquist, J. H. Nelson, and J. G. Pomonis. 1981. A^{13}-NMR study of the biosynthesis of 3-methylpentacosane in the American cockroach. Biochim. Biophys. Acta 663:536-555.

Enfield, F. D., D. T. North, and R. Erickson. 1981. Response to selection for resistance to gamma radiation in the cotton boll weevil. Ann. Entomol. Soc. Amer. 74(4):422-424.

English, L. H. and E. P. Marks. 1981. Beta-(2-furyl)-acryloyl phosphate hydrolase activity in insect cell surface membranes. Biochem. Biophys. Res. Commun. 101:775-783.

Goodpasture, C. E., R. D. Richard, D. Martin, and M. Laster. 1980. Sperm cell abnormalities in progeny from interspecific crosses between Heliothis virescens and H. subflexa. Ann. Entomol. Soc. Amer. 73:529-532.

Hammack, L. and W. E. Burkholder. 1981. Calling behaviour in female Trogoderma granarium Everts (Coleoptera:Dermestidae). J. Stored Prod. Res. 17:25-29.

LaChance. L. E. and C. P. Karpenko. 1981. Effect of seven antibiotics on the growth and reproduction of Heliothis subflexa x H. virescens interspecific hybrids and backcross males. Ann. Entomol. Soc. Amer. 74:493-497.

Leighton, T., E. P. Marks, and F. Leighton. 1981. Pesticides: Insecticides and fungicides are chitin synthesis inhibitors. Science 213:905-907.

Lum, P. T. M., J. Riemann, and J. E. Baker. 1981. The fertilization canal in Plodia interpunctella (Hubner) (Pyralidae:Lepidoptera). J. Invert. Reprod. 3:283-289.

McDonald, I. C. 1981. Genetics and the control of livestock pests. pp. 209-217. In F. Knapp (Ed.), Systems Approach to Animal Health and Production. University of Kentucky Printing Service, Lexington, Ky.

McDonald, I. C., O. A. Johnson, P. Evenson, and C. Nickel. 1981. House fly genetics: Fertility differences in mating of male translocation heterozygotes with different "normal" females. Ann. Entomol. Soc. Amer. 74:489-492.

Miller, R. W., C. Corley, C. F. Cohen, W. E. Robbins, and E. P. Marks. 1981. CGA-19255 and CGA-72662: Efficacy against flies and possible mode of action and metabolism. Southwest. Entomol. 6:272-278.

Nelson, D. R., J. W. Dillwith, and G. J. Blomquist. 1981. Cuticular hydrocarbons of the house fly, Musca domestica. Insect Biochem. 11:187-197.

Pomonis, J. G., H. M. Flint, and R. L. Smith. 1980. Analysis of volatiles from host and nonhost plants of the pink bollworm. J. Econ. Entomol. 73:783-786.

Reinecke, J. P. 1981. Endocrine system (invertebrate). pp. 174-176. In McGraw-Hill Yearbook of Science and Technology, 1980 Review, 1981 Preview.

Riemann, J. G., M. Johnson, and B. J. Thorson. 1981. Recovery of fertility by Mediterranean flour moths transferred from continuous light to light dark. Ann. Entomol. Soc. Amer. 74(3):274-278.

Roehrdanz, R. L. and J. C. Lucchesi. 1981. An X chromosome locus in Drosophila melanogaster that enhances survival of the triplo-lethal genotype Dp(Tp1). Devel. Genet. 2(2):147-158.

Willis, N. L., J. A. Seawright, C. Nickel, and D. J. Joslyn. 1981. Reciprocal translocations and partial correlation of chromosomes and linkage groups in the stable fly, Stomoxys calcitrans. J. Hered. 72:104-106.

Yakima, Washington

Akre, R. D., A. Greene, J. F. MacDonald, P. Landolt, and H. G. Davis. 1981. The yellowjackets of America north of Mexico. USDA Tech. Bull. 552.

Butler, L. I. and L. M. McDonough. 1981. Insect sex pheromones: Evaporation rates of alcohols and acetates from natural rubber septa. J. Chem. Ecol. 7:627-633.

Davis, H. G. and L. M. McDonough. 1981. Sex attractant for the filbertworm, Mellissopus latiferreanus (Wals.). Environ. Entomol. 10:390-391.

Howell, J. F., J. C. Maitlen, C. R. Sell, and R. B. Hutt. 1981. Codling Moth: The effects of volcanic ash and irrigation on spray residues and on moth control. Proc. Washington State Hort. Assoc., 76th, 163.

Jermy, T., B. A. Butt, L. M. McDonough, D. L. Dreyer, A. F. Rose. 1981. Antifeedants for the Colorado potato beetle. I. Antifeeding constituents of some plants from the sagebrush community. Insect. Sci. Appl. 1(3):237-242.

Kamm, J. A. and L. M. McDonough. 1980. Synergism of the sex pheromone of the cranberry girdler. Environ. Entomol. 9:795-797.

Maitlen, J. C. 1981. The GLC determination of residues of methiocarb and its toxic metabolites with the flame photometric detector after derivitization with methanesulfonyl chloride. J. Agric. Food Chem. 29:260-264.

Nash, R. G., P. C. Kearney, J. C. Maitlen, C. R. Sell, and S. N. Fertig. 1981. Agricultural worker exposure to 2,4-D. World Agric. Avia. 6:24-25.

PRINCIPAL CONTACTS - NRP 20250

Albany, California -

Dr. A. C. Waiss, Jr., RL
Plant Protection Phytochem. Lab.
USDA-ARS
Western Regional Research Center
800 Buchanan Street
Berkeley, CA 94710
Tel.: 415-486-3408
FTS: 449-3408

Dr. R. Teranishi, RL
Food Quality Research Unit
Tel.: 415-486-3161
FTS: 449-3161

Gainesville, Florida -

Dr. D. L. Chambers, LD
USDA-ARS
Insect Attractants, Behavior and
Basic Biology Research Lab.
P.O. Box 14565
Gainesville, FL 32604
Tel.: 904-373-6701
FTS: 947-7205

Dr. E. R. Mitchell, RL
Insect Ecology Research
Tel.: 904-373-6701
FTS: 947-7216

Dr. H. Oberlander, RL
Insect Physiology Research
Tel.: 904-373-6701
FTS: 947-7215

Dr. J. H. Tumlinson, RL
Insect Chemistry Research
Tel.: 904-373-6701
FTS: 947-7218

Beltsville, Maryland -

Dr. A. B. Borkovec, Lab. Chief
Insect Reproduction Lab.
USDA-ARS
Beltsville Agricultural Research Center
Beltsville, MD 20705
Tel.: 301-344-2136
FTS: 344-2136

Dr. D. K. Hayes, Lab. Chief
Livestock Insects Lab.
Tel.: 301-344-2474
FTS: 344-2474

Dr. K. R. Hill, Lab. Chief
Analytical Chemistry Lab.
Tel.: 301-344-2495
FTS: 344-2495

Dr. M. Jacobson, Lab. Chief
Biologically Active Natural Products Lab.
Tel.: 301-344-2025
FTS: 344-2025

Ms. E. M. Osborne, Lab. Chief
Chemical Coordination Unit
Tel.: 301-344-2137
FTS: 344-2137

Dr. J. R. Plimmer, Lab. Chief
Organic Chemicals Synthesis Lab.
Tel.: 301-344-2028
FTS: 344-2028

Dr. J. A. Svoboda, Lab. Chief
Insect Physiology Lab.
Tel.: 301-344-2389
FTS: 344-2389

Dr. R. E. Webb, Gypsy Moth Res. Coord.
Florist and Nursery Crops Lab.
Tel.: 301-344-2269
FTS: 344-2269

Otis Air National Guard Base, Massachusetts -

Dr. R. A. Bell, RL
USDA-ARS
Insect Nutrition, Rearing and Virology Research Lab.
APHIS-Otis Methods Development Center
Bldg. 1398
Otis ANGB, MA 02542
Tel.: 617-563-9303
FTS: 840-2709

Fargo, North Dakota -

Dr. G. Gassner, RL
Insect Genetics Cell Biology Research
USDA-ARS
Metabolism and Radiation Research Lab.
P.O. Box 5674 State University Station
Fargo, ND 58105
Tel.: 701-237-5771
FTS: 783-5451

Dr. D. R. Nelson, RL
Insect Physiology and Metabolism Res.
Tel.: 701-237-5771
FTS: 383-5465

Wyndmoor, Pennsylvania -

Dr. D. D. Bills, RL
Plant Science Research Lab.
USDA-ARS
Eastern Regional Research Center
Philadelphia, PA 19118
Tel.: 215-247-5242 Ext. 231
FTS: 489-5242

Yakima, Washington -

Dr. L. M. McDonough, RL
USDA-ARS
Yakima Agricultural Research Lab.
3706 W. Nob Hill Blvd.
Yakima, WA 98902
Tel.: 509-575-5970
FTS: 446-5970

National Research Program 20260
BIOLOGICAL AGENTS FOR PEST CONTROL

There are two major components of this National Research Program. One is directed to the utilization of natural enemies for the biological control of agricultural pests. The second component consists of the staff of the Systematic Entomology Laboratory whose research effort is directed to the identification of arthropods to support research and action programs in agricultural, biological, and health sciencies.

NPS Contact: J. J. Drea, Jr.

Technological Objective 1: New and improved technology for discovery and evaluation of parasites, predators, antagonists, and pathogens in foreign countries and for introduction and utilization of natural enemies for control of insects, weeds, plant pathogens, and other pests.

Research Locations:

Hurlingham, Argentina
Albany, California
Newark, Delaware
Gainesville, Florida
Sevres, France
Rome, Italy
Sapporo, Japan
Beltsville, Maryland
Frederick, Maryland
Stoneville, Mississippi
Columbia, Missouri
Temple, Texas

Examples of Recent Progress:

A program for distribution of phytophagous insects for control of weeds of range and pastures was begun in several States - Albany, California. A total of 41,981 individuals representing nine species of weed- feeding insects of exotic origin were sent to cooperators in 15 states, primarily western range states, for release against eight species of weeds: musk thistle, Canada thistle, milk thistle, Russian thistle, leafy spurge, spotted knapweed, diffuse knapweed, and Klamath weed.

Two European species of beetles were found to be host specific on leafy spurge - Albany, California. Two species of weevils in the genus Aphthona, A. flava and A. cyparissiae, proved to be host specific. Petition for their entry into North America will be made in 1982 for release against leafy spurge, a rangeland and pasture weed pest. D. Schroder, Commonwealth Institute of Biological Control, Delemont, Switzerland.

Exotic natural enemies were introduced for biological control - Newark, Delaware. During 1981, the Beneficial Insects Research Laboratory (BIRL) quarantine facility processed 116 lots of foreign insects, about 74,291 organisms from 17 different countries. A total of 65 beneficial species (109,569 specimens) were sent in 197 shipments to 45 research workers in 20 states and one foreign country. From these shipments, at least 38 species of

biological control agents were liberated in the United States against 20 target pests, including various aphids, the alfalfa blotch leafminer, lygus bugs, greenbug, the birch leafminer, the larch casebearer, the Mexican bean beetle, and the gypsy moth.

Complete biological control of alfalfa blotch leafminer attained in field studies - Newark, Delaware. Three species of European parasites of the alfalfa blotch leafminer, an accidentally introduced pest, were released at the laboratory alfalfa field in 1977 and became established in 1978. Parasitism by native parasites during the base period 1975-77 was 18% in the first cutting and 28% in the second cutting. In 1981, the native and introduced parasites together produced a parasitism of 72% and 71% in the first and second cuttings, respectively. This reduced the host populations below the threshhold of economic damage.

Parasites of the alfalfa weevil were found to continue to spread and increase in the Northeastern states - Newark, Delaware. The parasites reduced insecticide use by about 75% in 1981, with direct savings to agriculture of $9 million per year. This is approximately nine times the total cost of this project to the USDA over its 20-year duration. In addition, the possibilities of insecticide contamination of dairy products and the environment were also greatly reduced. Efforts continue, in cooperation with various states and with APHIS, to obtain similar benefits in other sections of the country, where parasites are established in only a few locations, and their benefits are much less significant.

An Asian moth accidentally introduced into Florida was found to prefer the aquatic weed hydrilla - Gainesville, Florida. The moth (Parapoynx diminutalis) which was accidentally introduced from Asia on hydrilla in Florida was also found on hydrilla in the Panama Canal Zone. Laboratory host-range studies showed that it could develop on at least 16 species of aquatic plants. In Florida, it apparently has a strong field preference for hydrilla, since it has been found only once on other plant species.

Natural enemies from Europe were shipped to United States and other countries as part of ARS overseas effort in biological control - Sevres, France. In 1981, 56 shipments, totaling 21,400+ specimens of more than 26 species of living organisms were shipped to the United States and, cooperatively or through prior agreement, to Canada, Italy, and the People's Republic of China for use against pest insects.

An inventory of beneficial European insects that attack the pear psylla was compiled - Sevres, France. An evaluation based on observed field attack and abundance indicates that predators are probably more important in controlling this pest in Europe than are parasites.

Five hundred and four adults of the long-horned beetle, Oberea erythrocephala, which feeds in the stems and roots of leafy spurge, were sent to the United States for field release in areas with severe leafy spurge infestations - Rome, Italy.

The sesiid moth Pyropteron chrysidiforme, a natural enemy of curly dock, was introduced into quarantine - Rome, Italy. This moth, whose larvae do severe damage to the roots of curly dock was introduced into quarantine at Stoneville, Mississippi, where the final testing will be done before release. This insect is the first natural enemy of this weed to be sent to quarantine in Mississippi.

A strain of the seed fly Urophora sirunaseva that will attack the seeds of the yellow starthistle was found in Greece - Rome, Italy. This insect was tested and released against yellow starthistle in California but was too host specific to attack the California plants. A new strain was discovered in Greece that accepts the California plants. Because the insect is from a different locality than the original insect, its responses to artichokes and safflowers are being field tested. The insect is expected to be sent to the United States in 1982.

Host specificity tests were completed on the flower fly Cheilosia grossa, which attacks musk thistle - Rome, Italy. This fly, whose larvae severely damage the stem and root of musk thistle plants, has passed all the normal host specificity tests for introduction into quarantine and has been found to be host specific. Tests on endangered species and native thistles remain to be completed before the insect is released.

New natural enemies of scale insects from Japan were sent to the United States - Sapporo, Japan. Chilochorus kuwanae, a ladybird beetle predator of the euonymus scale, and two wasp parasites (Metaphycus sp. and Pteropterix sp.) of the scale were collected in Japan and shipped to Newark, Delaware. C. kuwanae, which was collected from areas with a wide range of climatic conditions, is an important natural enemy of U. euonymi in Honshu.

A book describing the USDA gypsy moth natural enemy importation program was published - Beltsville, Maryland. Large-scale importations of natural enemies of the gypsy moth have been made in 1905 to 1914, 1922 to 1933, and 1961 to the present. The two earlier programs were documented in USDA publications of 1929 and 1962. The published record of imported gypsy moth natural enemies has now been brought up to 1977, to encompass USDA's expanded gypsy moth program.

New parasite of Colorado potato beetle was released in the Northeast - Beltsville, Maryland. Edovum puttleri, a newly introduced and described egg parasite of the Colorado potato beetle, was released, for the first time, in Maryland. About 61% of the eggs collected from the Maryland release site were parasitized.

Natural enemy of Canada thistle is now established in the United States - Beltsville, Maryland. A European gall fly, Urophora cardui, released in 1980 at Beltsville, Maryland, successfully overwintered and is now well established and dispersing. Canada thistle is one of the most important weeds of pasture and rights-of-way in the Northeast and is legally defined as a noxious weed in Maryland. The gall fly was introduced into Canada beginning in 1974 and is known to be established in New Brunswick, Ontario, and Quebec. This is the first known record of establishment of the species in the United States.

Host range and other characteristics of nematode parasite collected in Peru for use against corn rootworms were studied - Beltsville, Maryland. Field cage studies demonstrated that the nematode will successfully attack and develop in corn rootworms, Diabrotica sp. Although the nematode did attack three of 95 ladybird beetles, these beetles had been forced to the soil under artificial conditions. Normally, they will not be in contact with the soil to the same extent.

The Stoneville Research Quarantine Facility (SRQF) continues to serve as a regional and national center for the introduction of exotic beneficial organisms - Stoneville, Mississippi. In 1981, 167 shipments were received from 10 countries and held for screening and, in turn, 76 shipments of beneficial organisms were made from SRQF to cooperators. Studies of the introduced species indicate that some of them may be effective biocontrol agents of some of our most serious weed and crop pests.

Apanteles plutellae was recovered from field populations of the diamondback moth, Plutella xylostella - Columbia, Missouri. The imported parasite A. plutellae released near Columbia and St. Louis, Missouri, in 1979 and 1980, was recovered near Columbia in 1981. The parasite thus successfully overwintered and may be permanently established.

Charactization of a potential parasite for the biological control of the Colorado potato beetle - Columbia, Missouri. Studies in Missouri were instrumental in obtaining a description for the introduced eulophid egg parasite Edovum puttleri n.g., n.sp., of the Colorado potato beetle, and provided the impetus for research on the parasite in other areas of the United States.

Larvae of an introduced stem boring moth (Coleophora parthenica) were recovered from Russian thistle near Rio Grande City, Texas - Temple, Texas. The moth had spread 3 miles east, 1 mile south, and 1 mile west from the original release site. Populations of 3 to 4 larvae per plant were found at the center of the area. The moth did not establish at a west Texas release site.

Eggs, larvae, and adults of an introduced seed-head weevil (Rhinocyllus conicus) were recovered from milk thistle near Marlin, Texas - Temple, Texas. The weevil had spread more than a mile from the original release site. From 25 to 50% of the heads were damaged by the insect.

Technological Objective 2: New and improved technology for augmentation, manipulation, and conservation of introduced and native parasites, predators, antagonists, and pathogens for control of insects, weeds, plant pathogens, and other pests.

Research Locations:

Tucson, Arizona
Davis, California
Fresno, California
Tifton, Georgia
Peoria, Illinois
Beltsville, Maryland
Frederick, Maryland
Columbia, Missouri
Ithaca, New York
Brownsville, Texas
Temple, Texas

Geocoris punctipes was reared for five generations on the Debolt Lygus diet - Tucson, Arizona. Successful rearing of this important predator of Lygus bug for continuous generations on the relatively inexpensive and simple Debolt diet opens the way for development of larger-scale rearing for studies on the use of the predator for pest suppression. Some modifications in the diet may be needed, since the females produced were somewhat smaller and laid fewer eggs than those fed Lygus or bollworm eggs.

Plant pathogens offer possibilities as control agents against Canada thistle - Albany, California. Bacterial and fungal plant pathogens (Pseudomonas, Septoria, Xanthomonas, Alternaria, Puccinia, Fusarium, Sclerotium, Sclerotinia, and other genera) were recorded from Canada thistle in limited literature and field surveys (Montana, northwest North Dakota). Organisms of the first four genera were lab cultured and applied to C. arvense in small field lots with limited success. Sclerotinia damaged Canada thistle in further trials and may hold some biological control promise. F. Sharp, Montana State University.

A new plant pathogen for purslane was discovered in California - Davis, California. The discovery of the fungus Dichotomophthora portulacea attacking purslane offers a potential opportunity for the use of this fungus in an augmentative release program. Purslane is a serious weed in the high-value row crops of the State.

Sex pheromones of Heliothis zea found to serve as a kairomone for Trichogramma - Tifton, Georgia. The chemical odors emitted by H. zea females for the purpose of attracting males for mating were found to be detected by the egg parasite Trichogramma and utilized to locate H. zea eggs for attack. Application of the synthetic sex pheromone in fields using hollow fibers more than doubled parasitization by Trichogramma in a 24-hour period. The discovery of these overlapping roles of chemical cues in the mating behavior of H. zea and the host searching behavior of Trichogramma open exciting possibilities for combining augmentation-manipulation of parasites and mating disruption techniques into a powerful integrated pest management system for H. zea and similar pests.

Isozyme analysis techniques for 12 insect enzyme systems developed - Beltsville, Maryland. The development of isozyme techniques for 12 enzyme systems (and others soon to be developed) means that isozyme analyses can now be carried out on Trichogramma. Many of the tiny species of this wasp genus cannot now be distinguished from each other based on morphological characters. The results of these isozyme analyses, now made possible, will be used for the differentiation of species and identification of cryptic species and biotypes, which are not now possible based on morphology.

A plasmid in Bacillus thuringiensis that controls production of an insect toxin was identified - Beltsville, Maryland. This plasmid, a piece of extra chromosomal DNA, presumably controls the production of the mosquito toxin by Bacillus thuringiensis subsp. israelensis. Comparison of the wild-type B. thuringiensis subsp. israelensis and several crystal-free mutants revealed that

all mutants lacked a plasmid found in all the wild-type strains. It is now possible to study the effect of this plasmid when reintroduced into the mutant strains or into other bacteria in studies designed to explain the genetics of toxin production by this important insect pathogen.

A simple method was developed for transferring genetic information in gram-positive bacteria - Beltsville, Maryland. A simple method of conjugal transfer of genetic information between two species of gram-positive bacteria was discovered. Under the appropriate conditions on solid media, fusion occurs between cells of the two species permitting the exchange of genetic information. The next generation of cells from the fused parents contains new genetic traits. A means of transferring genetic information is the first step in the genetic engineering of this bacterium, and this ability to exchange genetic information will significantly enhance the genetic resources of Bacillus thuringiensis, an economically important insect control agent.

A chlamydia-like pathogen was identified and studied in over 15 insect species both laboratory reared and field collected - Beltsville, Maryland. This pathogen in low concentrations may cause erroneous conclusions in test insects used in bioassays. Its elimination from insect rearing will greatly benefit entomology research.

The aster yellows pathogen was differentiated from Spiroplasma citri - Beltsville, Maryland. Claims that the aster yellows pathogen is a strain of Spiroplasma citri have been made by three research groups and have gained some level of acceptance by general plant pathologists. Results based on the detailed study of transmission cycle, disease expression, and serology of the pathogens show that the agents are differentiable, unique, and probably require different strategies for study and management.

Acholeplasmas, members of a bacterial genus previously shown to infect insects on an experimental basis, were found to be common residents of plant surface habitats, which are important sites for transmission of insect pathogens - Beltsville, Maryland. The agents that are present may form a unique flora with special significance in insect microbiology.

A fungus shows potential as a biological control agent for sicklepod - Stoneville, Mississippi. Alternaria cassiae isolated from diseased sicklepod was pathogenic to sicklepod, coffee senna, and showy crotalaria. Soybeans, peanuts, cotton, corn, and 26 other crop and weed species in nine families were resistant to the pathogen. Host-range and virulence studies indicate that this fungus has potential for use as a biological herbicide. In irrigated field plots, the pathogen controlled 80% of the weed in 8 days.

Mass release of Trichogramma in cotton fields produced high levels of parasitism of Heliothis indicating potential effectiveness of this technique as applied in pilot test - Stoneville, Mississippi. Release of the egg parasite Trichogramma pretiosum at rates of 40,000 to 50,000 adults/acre resulted in up to 60 to 80% parasitism of Heliothis spp. eggs in cotton. Average parasitism from June to August was 35% in treated fields and less than 4% in untreated fields. Yield

(pounds lint/acre) and the number of undamaged bolls per acre were greater in fields where Trichogramma was released untreated. Nevertheless, Heliothis spp. populations (egg and larval) were about the same ($P<0.05$) in all fields. This study brought about several important advances: (a) it demonstrated that high rates of parasitism can be achieved by release of T. pretiosum and that T. pretiosum can be mass produced and transported for release; (b) it validated the use of the refrigerated device for wide-area parasite release; (c) it reaffirmed that numbers of predators are significantly ($P<0.05$) higher where parasites are released and hard insecticide applications are reduced (1.3 vs 3.8 applications/acre); (d) demonstrated that larval parasitism is a significant population suppressant; and (e) it demonstrated that the MOTHZV prediction model can be used to accurately time parasite releases in conjunction with whole plant examination.

Parasites were successfully used to introduce insect virus to field populations of the pest - Columbia, Missouri. Viruses specific for the imported cabbage worm and the cabbage looper were introduced into fields by mechanically contaminating the surfaces of three species of parasites. These introduced parasites plus viruses provided virus infection rates as high as 50% within 2 weeks.

Artificial conditions for velvet bean caterpillar oviposition were established - Columbia, Missouri. The adults were induced to oviposit on paper in plastic cages for the first time at this insectary, permitting establishment of a vigorous colony without contact with host plants. This reduced the contamination level of the larvae on artificial diet and increased rearing efficiency.

Isoelectric focusing was found to aid the identification of insect cell lines - Columbia, Missouri. Two closely related species of Heliothis that were indistinguishable by their isoenzyme patterns in conventional electrophoresis of cell extracts were readily distinguishable by the patterns when isoelectric focusing was used. This technique may prove useful in the identification of insect cell lines.

An antifeedant of the boll weevil was not toxic to parasitoids - Columbia, Missouri. Methyl eleostearate, an extract of tung nuts, was not toxic to the braconid fly Apanteles marginiventris and the tachinid fly Voria ruralis, treated at concentrations of $\leq$ 10,000 ppm, both parasitoids in the cotton ecosystem. At this concentration, the extract also did not adversely influence parasitization of the fall armyworm by A. marginiventris.

The chitinase activity of the fungus Beauveria bassiana was elucidated - Columbia, Missouri. The rate of hydrolysis of chitin changes appreciably during the life cycle of Beauveria bassiana. Activity was maximum at sporulation and minimum in conidia and germinating conidia. This suggests that host penetration may not be the most important role for chitinase in fungi.

Production techniques were devised to speed commercialization of fungi in the group Entomophthorales - Ithaca, New York. Fungi in this group are important pathogens of insects. Current research with Erynia radicans, a pathogen of the

spruce budworm, and Conidiobolus obscurus, a pathogen of most aphids, is directed, to a great extent, toward the development of these biotic agents as mycoinsecticides. Technology that will hasten the commercialization of the fungi will permit earlier large-scale use of the pathogens against the target pests.

Epizootics of the fungus Entomophaga grylli were triggered in populations of grasshoppers in field plots in South Dakota - Ithaca, New York. Two epizootics were produced in field populations of grasshoppers with spores collected from fungus-killed grasshoppers. This was made possible by the development and perfection of a new technique that permitted the extraction of fungus spores in the laboratory from dead grasshoppers. McDaniel, South Dakota State University, Brookings.

Search continues for isolates of Bacillus thuringiensis producing formulations that are more active than HD-1 or kill different insect species - Brownsville, Texas. Work with the International Cooperative Program on the Spectrum of Activities of B. thuringiensis is continuing. Approximately 1,000 isolates of B. thuringiensis are now in the culture collection. About 112 isolates that were part of the primary screening program and about 105 new isolates have been grown and distributed to all the cooperators. At Brownsville, 69 of the old isolates and 66 of the new isolates have been bioassayed against larvae of the cabbage looper and the tobacco budworm. The remaining 43 and 39 of the old and new isolates, respectively, are still being bioassayed.

Three isolates of Bacillus thuringiensis showed high activity against Spodoptera - Brownsville, Texas. Field tests in Egypt with B. thuringiensis isolates showed promise for controlling Spodoptera littoralis and S. exigua (the beet armyworm). H. S. Salama, Ministry of Agriculture, Egypt.

The production and fate of mesquite flowers and seed pods was determined throughout the growing season - Temple, Texas. Knowledge of the life cycle and the susceptibilities of various parts of this native plant to biotic agents would aid in reducing populations in the Southwest. The study showed that only 1.2% of mesquite flowers set fruit. Pods on the trees were attacked by fungi and several species of insects and pods on the ground were eaten by rabbits, rats, and cattle.

Technological Objective 3: New and improved principles and practices of insect and mite identification to support pest control technologies and other research and action programs in agricultural, biological, and health sciences.

Research Location:

Beltsville, Maryland

Identification manual of North American sawfly larvae was completed - Beltsville, Maryland. Keys to larvae of 12 families of Symphyta and 8 subfamilies of Tenthredinidae are given in the manual. A diagnosis,

description, discussion of biology and ecology, and list of hosts are presented for each species. Certain economically important species are discussed under each family or subfamily. This manual is a significant contribution to the study of this important group of plant-feeding insects.

The taxonomy of parasitic wasps was reanalyzed - Beltsville, Maryland. Ten species of chalcid wasps (in four families and four genera) were reanalyzed and found to be incorrectly identified and their known distributions largely incorrect. These species attack the beetle that transmits Dutch elm disease as well as lepidopterous pests of peanuts and rice. Their identity and newly established distributions permit accurate identification and provide a basis for possible release as biological control agents.

A parasite of the Colorado potato beetle was described - Beltsville, Maryland. This South American wasp is the first potential biological control agent of the Colorado potato beetle. Provision of the description and new name facilitates its introduction into the United States and Europe.

Taxonomic analysis of the mole cricket genus, Scapteriscus - Beltsville, Maryland. This economically important group of insects includes three species that cause about $80 million in damage to crops, turf, and pasture grass in the United States annually. The origins of these species, which were introduced accidentally into this country early in this century, have been identified. An additional species discovered in Puerto Rico may represent an accidental introduction onto that island as part of an early attempt to control another mole cricket species with biological control agents.

Study completed on the fruit fly genus, Rhagoletis, in Central and South America - Beltsville, Maryland. This study revealed that two species are capable of infesting commercially grown tomatoes along the west coast of South America, and that a third species causes considerable damage to the husk tomato, which is used extensively for cooking in Mexico. The 21 species are keyed, described, and illustrated so that they may be distinguished from each other and from all other fruit flies in the Americas south of the United States.

Chapters on gall midges (Cecidomyiidae), empidid flies (Empididae), and biting gnats (Ceratopogonidae) prepared for the Manual of Nearctic Diptera - Beltsville, Maryland. These chapters provide new, up-to-date keys to genera, new nomenclature, and references to species keys for these important families of flies. The book itself will be used for identification and for teaching Diptera systematics in universities.

Taxonomic analysis of the flower flies (Syrphidae) of the West Indies was published - Beltsville, Maryland. This combined identification manual and encyclopedic treatment is the first comprehensive analysis of the flower flies of any area of the New World tropics. It covers 129 species in 27 genera. Many of the species are predators of major pests such as sugar cane leafhoppers, various aphids, and whiteflies.

Predaceous midges from rice paddies in Thailand were collected and studied - Beltsville, Maryland. Twenty-six species were recognized, including nine new to science. Extensive revision of information in the existing literature was necessary and keys and check lists were prepared for this publication. Predaceous midges are of indirect benefit in biological control by reducing the numbers of aquatic non-host specific parasites and predators.

Identification tool for fly parasites of Heliothis was prepared - Beltsville, Maryland. Tachinid flies (Lespesia species) are important parasitoids of Heliothis pests of cotton, but their recognition has been difficult or impossible because the only identification key was inadequte. The new key will enable other taxonomists and biological control workers to identify specimens of the 29 beneficial species.

Computerized in-depth cataloging capability was developed - Beltsville, Maryland. A pilot project to capture taxonomic and biologic information about New World fruit flies has been completed. Instructive programs have been written; data from 125 publications are in the system; and an instruction manual for cataloging was written and revised. The system is being used by the entomological community.

Taxonomic analysis of the planthopper family, Cixiidae, in North America permits scientists to recognize many plant-feeding pests - Beltsville, Maryland. The study gives identification tools for the determination of 172 species in 13 genera. Several are proven vectors of plant pathogens; other probable vectors still need full investigation.

Major segments of and recent additions to the National Collection of Insects were reorganized - Beltsville, Maryland. The C. F. Baker collection of parasitic and predatory wasps and sawflies was acquired from Pomona College, and nearly 10,000 microscope slides representing over 580 species of aphids were donated by A. G. Robinson, Manitoba, Canada. A major collection of gall mites and gall mite illustrations was donated by H. H. Keifer, Sacramento, California. Subsequent reorganization of the collection and library has greatly facilitated the usefulness of the mite collection. Over 2,000 sawfly specimens from the A. E. Bower collection, mostly from Maine, were added to the collection, and the Huckett collection of several thousand house flies and root maggots reported last year has been incorporated into the collection. Specimens of parasitic wasps accumulated over the past 100 years have been sorted to family and properly placed within the curated collection. This represents more than 100,000 specimens and consolidates material that was inefficiently stored in wooden boxes. The major task of curating the North American Orthoptera collection has been completed and, along with the continuing curation of the Old World groups, will allow more efficient use of the collection for service identifications. Several thousand bombyliid flies from the Painter and Marston Collections obtained by USDA have been incorporated into the collection.

Identifications of insects and mites and taxonomic services were provided for federal, state, private, and foreign action and regulatory agencies - Beltsville, Maryland. During 1981, scientists in the Laboratory provided over 20,000 authoritative identifications of nearly 114,000 specimens of pest, beneficial, and non-target insects and mites. These identifications enabled other scientists in ARS, APHIS, FS, and state, private, and foreign agencies to conduct research on IPM, biological control, and other insect and mite problems. They were also an integral part of APHIS/PPQ's programs for preventing the establishment of exotic pests and for biocontrol of introduced pest species.

P U B L I C A T I O N S

Tucson, Arizona

Cohen, A. C. 1981. An artificial diet for Geocoris punctipes (Say). Southwest. Entomol. 6:109-113.

Graham, H. M. and C. G. Jackson. 1981. Ovipositional sites of the minute pirate bug in alfalfa stems. Southwest. Entomol. 6:190-194.

Thompson, S. N. 1981. Brachymeria lasus and Pachycrepoidus vindemiae: Sterol requirements during larval growth of two hymenopterous insect parasites reared in vitro on chemically defined media. Exp. Parasitol. 51:220-235.

Thompson, S. N. 1981. Essential amino acid requirements of four species of parasitic Hymenoptera. Comp. Biochem. Physiol. 69A:173-174.

Thompson, S. N. 1981. Brachymeria lasus: Culture in vitro of a chalcid insect parasite. Exp. Parasitol. 52:414-418.

Albany, California

Maddox, D. M. 1981. Introduction, phenology, and density of yellow starthistle in coastal, intercoastal, and central valley situations in California. USDA, ARS, Agr. Res. Results, ARR-W-20/July, 33 pp.

Rosenthal, S. S. 1981. European organisms of interest for the biological control of Convolvulus arvensis in the United States. Proc. V Int. Symp. Biol. Contr. Weeds, Brisbane, 1980, pp. 537-544.

Rosenthal, S. S. and N. Hostettler. 1980. Galeruca rufa (Col.: Chrysomelidae) seasonal life history and the effect of its defoliation on its host plant, Convolvulus arvensis (Convolvulaceae). Entomophaga 25(4):318-388.

Fresno, California

Morris, T. J., P. V. Vail, and S. S. Collier. 1981. An RNA virus in Autographa californica nuclear polyhedrosis virus preparations. I. Detection and identification. J. Invertebr. Pathol. 38:201-208.

Newark, Delaware

Burbutis, P. P., N. Erwin, and L. R. Ertle. 1981. Reintroduction and establishment of Lydella thompsoni and notes on other parasites of the European corn borer in Delaware. Environ. Entomol. 10:779-781.

Day, W. H. 1981. Biological control of the alfalfa weevil in the northeastern United States. Chapter 25 in G. C. Papavizas (ed.), Beltsville Symposia in Agriculture Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Day, W. H. 1981. Harry W. Allen, 1892-1981. Entomol. News 92(4).

Dysart, R. J. 1981. A new computer data bank for introduction and release of beneficial organisms. Chapter 8 in G. C. Papavizas (ed.), Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Hedlund, R. C., L. R. Ertle, and J. R. Coulson. 1981. Quarantine processing of exotic species and distribution to various laboratories, 1961-1977. pp. 353-355 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Schaefer, P. W. 1981. A black-backed larval mutant of Lymantria dispar (L.) (Lepidoptera: Lymantriidae) in Japan. J. Res. Lepid. 18(3):167-170. 1979(81).

Schaefer, P. W. 1981. Explorations in Japan and Korea by the ARS Asian Parasite Laboratory, 1975-77. pp. 340-348 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Schaefer, P. W. and P. J. Castrovillo. 1981. Gynaephora rossii (Curtis) on Mt. Katahdin, Maine, and Mt. Daisetsu, Japan, and comparisons to records for populations from the Arctic (Lymantriidae). J. Res. Lepid. 14(4):241-250. 1979(81).

Schaefer, P. W. and H. Shima. 1981. Tachinidae parasitic on the Lymantriidae in Japan. Kontyu 49(2):367-384.

Gainesville, Florida

Buckingham, G. R. and C. A. Bennett. 1981. The laboratory biology and behavior of Litodactylus leucogaster, a ceutorhynchine weevil that feeds on watermilfoils. Ann. Entomol. Soc. Am. 74:451-458.

Buckingham, G. R. and B. M. Ross. 1981. Notes on the biology and host specificity of Acentria nivea (= Acentropus niveus). J. Aquat. Plant Manage. 19:32-36.

Sevres, France

Drea, J. J., Jr. 1981. Agricultural Research Service sponsored Public Law 480 project in Yugoslavia: 1972-75. In Chapter 6, Parasites, pp. 315-317. In C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Fuester, R. W., J. J. Drea, Jr., F. Gruber, F. Herard. 1981. Explorations in Europe and Iran by the ARS European Parasite Laboratory, 1972-77. pp. 324-340 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Hedlund, R. C. and R. F. W. Schroder. 1981. Alternate host studies. In Chapter 6. Parasites, pp. 372-375. In C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Herard, F. and J. J. Drea, Jr. 1981. Agricultural Research Service sponsored Public Law 480 project in Morocco: 1972-75. In Chapter 6, Parasites, pp. 317-321. In C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584.

Hoyer, H. 1981. Foreign exploration, collection, and shipment of parasites and predators. Proc. of Workshop "Status of Biological Control of Filth Flies," pp. 128-130.

Tifton, Georgia

Altieri, M. A., W. J. Lewis, D. A. Nordlund, R. C. Gueldner, and J. W. Todd. 1981. Chemical interactions between plants and Trichogramma wasps in Georgia soybean fields. Protection Ecol. 3:259-263.

Beevers, M., W. J. Lewis, H. R. Gross, Jr., and D. A. Nordlund. 1981. Kairomones and their use for management of entomophagous insects. X. Laboratory studies on manipulation of host-finding behavior of Trichogramma pretiosum Riley with a kairomone extracted from Heliothis zea (Boddie) moth scales. J. Chem. Ecol. 7:635-648.

Nordlund, D. A., W. J. Lewis, H. R. Gross, Jr., and M. Beevers. 1981. Kairomones and their use for management of entomophagous insects. XII. The stimulatory effects of host eggs and the importance of host-egg density to the effective use of kairomones for Trichogramma pretiosum Riley. J. Chem. Ecol. 7:909-917.

Nordlund, D. A. and C. E. Sauls. 1981. Kairomones and their use for management of entomophagous insects. XI. Effect of host plants on the kairomonal activity of frass from Heliothis zea larvae for the parasitoid Microplitis croceipes. J. Chem. Ecol. 7:1057-1061.

Peoria, Illinois

Johnson, D. E. 1981. Toxicity of Bacillus thuringiensis entomocidal protein toward cultured insect tissue. J. Invertebr. Pathol. 38:94-101.

Johnson, D. E. and B. Freedman. 1981. Toxicity of Bacillus thuringiensis Spo^{-} Cr^{+} mutants for the European corn borer Ostrinia nubilalis. Appl. Environ. Microbiol. 42:385-387.

Beltsville, Maryland

Anderson, D. M. 1981. Key to larvae of Coleoptera infesting stored products, Part I. Families. APHIS-PPQ Training Center, Frederick, MD.

Anderson, D. M. and R. D. Gordon. 1981. The species of Scarabaeidae (Coleoptera) associated with sugarcane in South Florida. Fl. Entomol. 64(1): 120-138.

Anderson, D. M., R. D. Gordon, J. M. Kingsolver, T. J. Spilman, R. E. White, and D. R. Whitehead. 1981. Illustrated keys to adult and larval beetles. APHIS-PPQ Training Center, Frederick, MD.

Batra, S. W. T. 1981. Puccinia xanthii forma specialis ambrosiatrifidae: A microcyclic rust for the biological control of giant ragweed, Ambrosia trifida (Compositae). Mycopathologia 73:61-64.

Batra, S. W. T. 1981. Biological control of weeds: Principles and prospects. pp. 45-59 in G. C. Papavizas (ed.), Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld Osmun & Co., Totowa, NJ.

Batra, S. W. T. 1981. Biological control of Carduus thistles along roadsides in northeastern States. NAS/NRC Transportation Res. Record 805 (Roadside Maintenance): 1-2.

Batra, S. W. T., J. R. Coulson, P. H. Dunn, and P. E. Boldt. 1981. Insects and fungi associated with Carduus thistles (Compositae). USDA Tech. Bull. 1616, 100 pp.

Beauchamp, R., J. Kingsolver, and T. Parker. 1981. Reference listing of museum pests. Appendix C (5 pp.). In S. R. Edwards, B. M. Bell, and M. E. King (eds.), Pest Control in Museums: A status report (1980). 34 pp. Assoc. System. Collections, Lawrence, KS.

Burger, J. F. and F. C. Thompson. 1981. The Tabanus striatus complex (Diptera: Tabanidae): A revision of some Oriental horse fly vectors of surra. Proc. Entomol. Soc. Wash. 83: 339-358.

Clark, W. E. and D. M. Anderson. 1981. The genus Chionanthobius Pierce (Coleoptera: Curculionidae): Descriptions of a new species on Forestiera (Oleaceae) and of the larva and pupa of C. schwarzi Pierce. Proc. Entomol. Soc. Wash. 83(2): 185-197.

Coulson, J. R. (ed.). 1981. Proceedings of the Joint American-Soviet Conference on Use of Beneficial Organisms in the Control of Crop Pests. Entomol. Soc. Am., College Park, MD, 62 pp.

Coulson, J. R. 1981. The Soviet-American environmental agreement and exchange of beneficial organisms, 1972-1979. pp. 1-11 in J. R. Coulson (ed.), Proc. of the Joint American-Soviet Conf. on Use of Beneficial Organisms in the Control of Crop Pests. Entomol. Soc. Am., College Park, MD., 62 pp.

Coulson, J. R. 1981. Parasites: Foreign explorations: Recent history, 1961-77. pp. 302-310 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584, 757 pp.

Coulson, J. R. 1981. Miscellaneous overseas activities in Japan, the U.S.S.R., and India, 1972-77. pp. 322-324 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584, 757 pp.

Coulson, J. R. 1981. Attempts after 1960: Distribution and attempted establishment of parasites. pp. 351-353 in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584, 757 pp.

Coulson, J. R. 1981. Nematode, Mermithidae, pp. 370-372 in C. C. Doane and M. L. McManus (eds.) The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584, 757 pp.

Crook, P. G., J. A. Novak, and T. J. Spilman. 1981. The lesser mealworm, Alphitobius diaperinus, in the scrotum of Rattus norvegicus, with notes on other vertebrate associations (Coleoptera, Tenebrionidae, Rodentia, Muridae). Coleopt. Bull. 34(4), 1980 (1981):393-396.

Dougherty, E. M., R. M. Weiner, J. L. Vaughn, and C. F. Reichelderfer. 1981. Physical factors that affect in vitro Autographa californica nuclear polyhedrosis virus infection. Appl. Environ. Microbiol. 41:1166-1172.

Drea, J. J., Jr. and E. G. King. 1981. The coordination of scientific and commercial aspects of biological control of filth breeding flies. In Proc. Workshop "Status of Biological Control of Filth Flies." Southern Reg. Publ., ARS/USDA.

Duffield, R. M. 1981. Biology of Microdon fuscipennis (Diptera: Syrphidae) with interpretation of the reproductive strategies of Microdon species found north of Mexico. Proc. Entomol. Soc. Wash. 83:716-724.

Duffield, R. M., M. Shamim, J. W. Wheeler, and A. S. Menke. 1981. Alkylpyrazines in the mandibular gland secretions of Ammophila wasps. Comp. Biochem. Physiol. 70B:317-318.

Faust, R. M. and R. S. Travers. 1981. Occurrence of resistance to neomycin and kanamycin in Bacillus popilliae and certain serotypes of Bacillus thuringiensis: mutation potential in sensitive strains. J. Invertebr. Pathol. 37:113-116.

Feinsinger, P., E. Spears, and R. W. Poole. 1981. A simple measure of niche breadth. Ecology 62:27-32.

Ferguson, D. C. 1981. Response to J. C. E. Riotte's review of the lymantriid fascicle of the Moths of America North of Mexico. J. Res. Lepid. 17:265-267.

Ferguson, D. C. and V. A. Brou. 1981. A new species of Automeris (Lepidoptera, Saturniidae) from the Mississippi River Delta. J. Lepid. Soc. 35:101-105.

Foote, R. H. 1981. The genus Rhagoletis Loew south of the United States (Diptera: Tephritidae). USDA Tech. Bull. 1607, 75 pp.

Gagne, R. J. 1981. Chrysomya spp., Old World blow flies (Diptera: Calliphoridae), recently established in the Americas. Bull. Entomol. Soc. Am. 27:21-22.

Gagne, R. J. 1981. Chapter 16. Cecidomyiidae, pp. 257-292. In J. F. McAlpine et al., Manual of Nearctic Diptera. Vol. I. Research Branch, Agriculture Canada Monograph No. 27. Ottawa. 673 pp.

Gagne, R. J. 1981. A new species of Endaphis (Diptera: Cecidomyiidae) endoparasitic in aphids in British Columbia. Proc. Entomol. Soc. Wash. 83: 222-224.

Gagne, R. J. 1981. A monograph of Trichonta with a model for the distribution of Holarctic Mycetophilidae (Diptera). USDA Tech. Bull. 1638.

Gagne, R. J. 1981. A new species of North American Cecidomyiidae (Diptera) from Spartina alterniflora (Poaceae). Proc. Entomol. Soc. Wash. 83:129-132.

Gordon, R. D. 1981. New species of North American Hydroporus, niger-tenebrosus group (Coleoptera: Dytiscidae). Pan-Pacific Entomol. 57:105-123.

Grissell, E. E. 1981. Nesting behavior of Prionyx "thomae" (Fabricius). J. Kans. Entomol. Soc. 54:16-21.

Grissell, E. E. 1981. The identity of Nearctic Cerocephala Westwood. Proc. Entomol. Soc. Wash. 83:620-624.

Grissell, E. E. 1981. Edovum puttleri, n.g., n. sp., an egg parasite of the Colorado potato beetle. Proc. Entomol. Soc. Wash. 83:790-796.

Grissell, E. E. and C. E. Goodpasture. 1981. A review of Nearctic Podagrionini, with description of sexual behavior of Podagrion mantis. Ann. Entomol. Soc. Am. 74:226-241.

Grissell, E. E. and M. E. Schauff. 1981. New Nearctic Invreia from lepidopterous pests of peanut. Proc. Entomol. Soc. Wash. 83:1-12.

Henry, T. J. 1981. A new eastern United States Psallus Fieber from Physocarpus. Proc. Entomol. Soc. Wash. 83:399-402.

Henry, T. J. 1981. Review of "The semiaquatic and aquatic Hemiptera of California" edited by A. S. Menke. Proc. Entomol. Soc. Wash. 83:178-180.

Henry, T. J. 1981. Review of "The plant bugs of the Prairie Provinces of Canada" by L. A. Kelton. Proc. Entomol. Soc. Wash. 83:809-810.

Hoebeke, E. R. and D. A. Nickle. 1981. The forest cockroach, Ectobius sylvestris (Poda), a European species newly discovered in North America (Dictyoptera: Blattodea: Ectobiidae). Proc. Entomol. Soc. Wash. 83:592-595.

Iizuka, T., R. M. Faust, and R. S. Travers. 1981. Comparative profiles of extrachromosomal DNA in single and multiple crystalliferous strains of Bacillus thuringiensis variety kurstaki. J. Fac. Agric., Hokkaido Univ. 60:143-151.

Iizuka, T., R. M. Faust, and R. S. Travers. 1981. Isolation and partial characterization of extrachromosomal DNA from serotypes of Bacillus thuringiensis pathogenic to lepidopteran and dipteran larvae by agarose gel electrophoresis. Nippon Sanshigaku Zasshi 50:120-133.

Kaplan, M. and F. C. Thompson. 1981. New Syrphidae from Israel (Diptera). Proc. Entomol. Soc. Wash. 83: 198-212.

Kingsolver, J. M. 1981. Synonymical notes on New World Bruchidae (Coleoptera) and an emendation. Proc. Entomol. Soc. Wash. 83: 545.

Kingsolver, J. M. 1981. Illustrated guide to common insect pests in museums. Appendix B (20 pp.). In S. R. Edwards, B. M. Bell, and M. E. King (eds.) Pest Control in Museums: A status report (1980). 34 pp. Assoc. System. Collections, Lawrence, KS.

Kingsolver, J. M. 1981. Two new species of Acanthoscelides (Coleoptera: Bruchidae) associated with Phaseolus (Leguminosae) from Argentina, with the description of a new species group, and a new synonym. Proc. Entomol. Soc. Wash. 82:52-59.

Knutson, L., J. J. Drea, Jr., and J. R. Coulson. 1981. Research on entomophagous insects: exploration, introduction, evaluation, and biosystematics, pp. 169-180. In Proc. 1st Japan/USA Symp. on Integrated Pest Management, Tsukuba (Japan), September 29-30, 1981.

Knutson, L. 1981. Sciomyzidae, pp. 310-312. In S. H. Herlbert, G. Rodriguez, and N. D. Santos (eds.), Aquatic Biota of Tropical South America, Part 1: Arthropods. San Diego State Univ., San Diego, CA, 323 pp.

Knutson, L. 1981. New combinations and synonymies in Palearctic and Nearctic Sciomyzidae (Diptera). Proc. Entomol. Soc. Wash. 83(2):332-338.

Knutson, L. 1981. Symbiosis of biosystematics and biological control. pp. 61-78 in G. C. Papavizas (ed.) Beltsville Symposia in Agricultural Research 5: Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ, 461 pp.

Kramer, J. P. 1981. Taxonomic study of the planthoppers, genus Cixius in the United States and Mexico. Trans. Am. Entomol. Soc. 107:1-8.

Martin, P. A. W., J. R. Lohr, and D. H. Dean. 1981. Transformation of Bacillus thuringiensis protoplasts by plasmid deoxyribonucleic acid. J. Bacteriol. 145: 980-983.

Menke, A. S. 1981. Sphecos, a newsletter for aculeate wasp researchers, Issue #4.

Miller, S. E., R. D. Gordon, and H. F. Howden. 1981. Re-evaluation of Pleistocene scarab beetles from Rancho La Brea, California (Coleoptera: Scarabaeidae). Proc. Entomol. Soc. Wash. 83:625-630.

Miller, D. R. 1981. Reply to Danzig and Kerzhner. Bull Zool. Nomen. 38:82-83.

Miller, D. R. 1981. Recent publications on scale insects. Coccidol. Newsl. 7:24-60.

Miller, D. R. and F. W. Howard. 1981. A new species of Abgrallaspis from Louisiana. Ann. Entomol. Soc. Am. 74:164-166.

Miller, S. E. and A. S. Menke. 1981. Entomological bibliography of the California Islands. Santa Barbara Mus. Nat. Hist. Occas. Pap. 11, 78 pp.

Nickle, D. A. and D. W. Hagstrum. 1981. Provisioning with preparalyzed hosts to improve parasite effectiveness: A pest management strategy for stored commodities. Environ. Entomol. 10:560-564.

Nickle, D. A. and J. Harper. 1981. Predation on a mouse by the Chinese mantid Tenodera aridifolia sinensis Saussure (Dictyoptera: Mantoidea). Proc. Entomol. Soc. Wash. 83:801-802.

Nickle, W. R. 1981. Mermithid parasites of agricultural pest insects. J. Nematol. 13:262-266.

Nickle, W. R. 1981. Nematodes with potential for biological control of insects and weeds. Chapter 13. Pp. 181-199 in G. C. Papavizas (ed.) Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Orth, R. E. and G. C. Steyskal. 1981. A new species of Pherbellia Robineau-Desvoidy separated from a previously described North American species (Diptera: Sciomyzidae). Proc. Entomol. Soc. Wash. 83:99-104.

Peterson, R. D., R. J. Gagne, V. W. Snow, and J. P. Spencer. 1981. Attraction of non-target organisms to SWASS. Environ. Entomol. 10:511-516.

Reardon, R. C. and J. R. Coulson. 1981. Miscellaneous overseas activities in Spain and Yugoslavia, 1967-70. pp. 321-322. in C. C. Doane and M. L. McManus (eds.), The Gypsy Moth: Research Toward Integrated Pest Management. USDA Tech. Bull. 1584, 757 pp.

Ridgway, R. L., J. R. Ables, C. Goodpasture, and A. W. Hartstack. 1981. Trichogramma and its utilization for crop protection in the U.S.A. pp. 41-48 in J. R. Coulson (ed.), Proceedings of the Joint American-Soviet Conference on Use of Beneficial Organisms in the Control of Crop Pests. Entomol. Soc. Am., College Park, MD, 62 pp.

Sabrosky, C. W. 1981. A partial revision of the genus Eucelatoria (Diptera, Tachinidae), including important parasites of Heliothis. USDA Tech. Bull. 1635: 1-18.

Schroder, R. F. W. 1981. Biological control of the Mexican bean beetle, Epilachna varivestis Mulsant, in the United States. pp. 351-360 in G. C. Papavizas (ed.) Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Smiley, R. L. 1981. Studies on the idiosomal and leg chaetotaxy of the Cheyletidae with descriptions of a new genus and four new species. Int. J. Acarol. 7:109-127.

Smith, D. R. 1980. Pergidae (Hymenoptera) from New Guinea and Australia in the Bishop Museum. Pacific Insects 22(3-4):329-346.

Smith, D. R. 1981. Identification of the Acordulecera "potato" sawflies of Peru and Bolivia, with descriptions of these and related species from South America (Hymenoptera: Pergidae). J. Wash. Acad. Sci. 70(2):89-103.

Smith, D. R. 1981. Sawflies (Hymenoptera: Symphyta) from George Lake, Alberta. Quaestiones Ent. 16:671-675.

Smith, D. R. 1981. New records for Eriotremex (Hymenoptera: Siricidae) from Southeast Asia and New Guinea. Proc. Entomol. Soc. Wash. 83:389.

Smith, D. R. 1981. Studies on leaf-mining sawflies of the tribe Fenusini in Asia (Hymenoptera: Tenthredinidae). Proc. Entomol. Soc. Wash. 83:763-771.

Steyskal, G. C. 1981. Six new North American species of Melanagromyza Hendel (Diptera, Agromyzidae). J. Wash. Acad. Sci. 70:36-43.

Steyskal, G. C. and L. V. Knutson. 1981. Empididae/47. Pp. 603-624 in J. F. McAlpine et al., Manual of Nearctic Diptera, Vol. I. Research Branch, Agriculture Canada Monograph 27, 674 pp.

Steyskal, G. C. 1981. Book Review. The insects and arachnids of Canada. Part I. Collecting, preparing, and preserving insects, mites, and spiders. Compiled by J. E. H. Martin. Proc. Entomol. Soc. Wash. 83:181.

Steyskal, G. C. 1981. A bibliography of the Malaise trap. Proc. Entomol. Soc. Wash. 83:225-229.

Steyskal, G. C. 1981. A new "bobo" fly from the Gulf of California (Diptera: Chamaemyiidae: Paraleucopis mexicana). Proc. Entomol. Soc. Wash. 83:403-405.

Steyskal, G. C. 1981. A new species of Rhagoletotrypeta (Diptera: Tephritidae) from Texas, with a key to the known species. Proc. Entomol. Soc. Wash. 83: 707-712.

Steyskal, G. C. 1981. Book Review of "Glossary of mosquito anatomy," by R. E. Harbach and K. L. Knight. Proc. Entomol. Soc. Wash. 83:805-809.

Stiller, D., R. F. Whitcomb, M. E. Coan, J. G. Tully. 1981. Direct isolation in cell-free medium of a spiroplasma from Haemaphysalis leporispalustris (Packard) (Acari: Ixodidae) in Maryland. Curr. Microbiol. 5:339-342.

Stoetzel, M. B. 1981. Two new species of Phylloxera on pecan. J. Ga. Entomol. Soc. 16:127-144.

Stoetzel, M. B. 1981. Investigation of two species of Phylloxera on pecan in Georgia. J. Ga. Entomol. Soc. 16:144-150.

Stoetzel, M. B. 1981. Book Review of "W. M. Maskell's Homoptera: Species-group names and type-material" by L. L. Dietz and M. F. Tocker. Bull. Entomol. Soc. Amer. 27:153.

Thompkins, G. J., J. L. Vaughn, J. R. Adams, and C. F. Reichelderfer. 1981. Effects of propagating Autographa californica nuclear polyhedrosis virus and its Trichoplusia ni variant in different hosts. Environ. Entomol. 10:801-806.

Thompson, F. C. 1981. Anaspis Muller, 1764, etc. Comments on proposed designations of types species. Z.N. (S.) 2240. Bull. Zool. Nomencl. 38:7.

Thompson, F. C. 1981. Nomenclature of the European species of Neoascia Williston (Diptera: Syrphidae). Entomol. Scand. 12:470-478.

Thompson, F. C. 1981. The flower flies of the West Indies (Diptera: Syrphidae). A Synopsis. Mem. Entomol. Soc. Wash. 9, 200 pp.

Thompson, F. C. 1981. Revisionary notes on Nearctic Microdon flies (Diptera: Syrphidae). Proc. Entomol. Soc. Wash. 83:725-758.

Thompson, F. C. and W. N. Mathis. 1981. Haliday's generic names of Diptera first published in Curtis' A Guide to ... British Insects (1837). J. Wash. Acad. Sci. 70:80-89 (1980).

Todd, E. L. and R. W. Poole. 1981. Moths of the parvula complex of Lacinipolia McDunnough (Noctuidae: Hadeninae). Fla. Entomol. 64:183-189.

Tully, J. G., D. L. Rose, C. E. Yunker, J. Cory, R. F. Whitcomb, and D. L. Williamson. 1981. Helical mycoplasmas (spiroplasmas) from Ixodes ticks. Science 212:1043-1045.

Walker, T. J. and D. A. Nickle. 1981. Introduction and spread of pest mole crickets: Scapteriscus vicinus and S. acletus reexamined. Ann. Entomol. Soc. Am. 74:158-163.

Weiss, S. A., G. C. Smith, S. S. Kalter, and J. L. Vaughn. 1981. Improved method for the production of insect cell cultures in large volume. In vitro 17: 495-502.

Weiss, S. A., G. C. Smith, J. L. Vaughn, and E. M. Dougherty. 1981. Improved replication of Autographa californica nuclear polyhedrosis virus in roller bottles: Characterization of the progeny virus. Intervirology 15:213-222.

Wheeler, A. G., Jr. and T. J. Henry. 1981. Seasonal history and habits of the European alfalfa beetle, Subcoccinella virgintiquatuorpunctata (L.) Coleopt. Bull. 35:197-203.

Wheeler, A. G., Jr. and T. J. Henry. 1981. Jalysus spinosus and J. widkhami: taxonomic clarification, review of host plants and distribution, key to adults and fifth instars. Ann. Entomol. Soc. Am. 79:1106-1113.

White, R. E. 1981. A key to tropical species of Tricorynus, with taxonomic changes (Coleoptera: Anobiidae). Proc. Entomol. Soc. Wash. 83:772-784.

White, R. E. 1981. The genus Uroplata, type-species and authorship (Coleoptera: Chrysomelidae). Proc. Entomol. Soc. Wash. 83:713-715.

White, R. E. 1981. Three new species of Anobiidae from southwestern United States and northwestern Mexico (Coleoptera). Proc. Entomol. Soc. Wash. 83: 472-478.

White, R. E. 1981. Review of Vrilletta, with two new species and a key (Coleoptera: Anobiidae). J. Wash. Acad. Sci. 70:144-148.

White, R. E. 1981. Homonymy in world species-group names of Criocerinae. USDA Tech. Bull 1629, 69 pp.

Whitehead, D. R. 1980 (1981). The weevil Apion (Perapion) curtirostre Germar in North America, and the systematic position of Perapion Wagner with a review of the North American species (Coleoptera: Curculionidea: Apionidae). Coleopt. Bull. 34:397-400 (issued January 29, 1981).

Whitehead, D. R. 1980 (1981). Book Review: Probable evolution and morphological variation in South American disonychine flea beetles (Coleoptera: Chrysomelidae) and their amaranthaceous hosts, by G. B. Vogt, J. U. McGuire, Jr., and A. D. Cushman. (USDA Tech. Bull. 1593). Coleopt. Bull. 34:352-354 (issued January 29, 1981).

Wilder, D. Dee. 1981. A revision of the genus Oreothalia Melander (Diptera: Empididae). Proc. Entomol. Soc. Wash. 83:461-471.

Frederick, Maryland

Emge, R. G., J. S. Melching, and C. H. Kingsolver. 1981. Epidemiology of Puccinia chondrillina, a rust pathogen for the biological control of rush skeleton weed in the United States. Phytopathology 71:839-843.

Emge, R. G. and G. E. Templeton. 1981. Biological control of weeds with plant pathogens. pp. 219-226 in G. C. Papavizas (ed.), Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Stoneville, Mississippi

King, E. G. 1981. Production, release, and evaluation of predators and parasites of arthropod pests attacking food and fiber crops in the USA, pp. 154-168. In Proc. 1st Japan/USA Symp. on Integrated Pest Management, Tsukuba (Japan), September 29-30, 1981.

Mohyuddin, A. I., C. Inayatullah, and E. G. King. 1981. Host selection and strain occurrence in Apanteles flavipes (Cameron) (Hymenoptera: Braconidae) and its bearing on biological control of graminaceous stem borers (Lepidoptera: Pyralidae). Bull. Entomol. Res. 71:575-581.

Parkman, P., M. Shepard, and J. Powell. 1981. Oviposition biology and population dynamics of Euplectrus plathypenae Howard (Hymenoptera: Eulophidae). J. Georgia Entomol. Soc. 16:336-341.

Powell, J. E., M. Shepard, and M. J. Sullivan. 1981. Use of heating degree day and physiological day equations for predicting development of the parasitoid, Trissolcus basalis. Environ. Entomol. 10:1008-1011.

Walker, H. L. 1981. Granular formulation of Alternaria macrospora for control of spurred anoda (Anoda cristata). Weed Sci. 29:342-345.

Walker, H. L. 1981. Factors affecting biological control of spurred anoda (Anoda cristata with Alternaria macrospora). Weed Sci. 29:505-507.

Walker, H. L. 1981. Fusarium lateritium: A pathogen of spurred anoda (Anoda cristata), velvetleaf (Abutilon theophrasti), and prickly sida (Sida spinosa). Weed Sci. 29:629-631.

Walker, H. L. and G. L. Sciumbato. 1981. Host range studies on four Alternaria isolates pathogenic to cotton (Gossypium spp.) or spurred anoda (Anoda cristata). Plant Sci. Letters 22:71-75.

Walker, H. L. and G. L. Sciumbato. 1981. Alternaria macrospora: A fungus that kills spurred anoda. Miss. Agric. For. Exp. Sta. Res. Rpt. 6(9), 2 pp.

Columbia, Missouri

Couch, T. L. and C. M. Ignoffo. 1981. Formulation of insect pathogens. Chapter 34, pp. 621-634 In H. D. Burges (ed.), Microbial Control of Pests and Plant Diseases, 1970-1980. New York, Academic Press.

Coudron, T. A., J. H. Law, and J. K. Koeppe. 1981. Insect hormones. Trends Biochem. Sci. 6(9):248-251.

Ignoffo, C. M. 1981. Progress in microbial control (1975-1980): Developing integrated pest management programs for soybeans. In Proc. of Workshop on Insect Pest Management with Microbial Agents: Recent Achievements, Deficiencies, and Innovations, Boyce-Thompson Institute (May 12-15, 1980). 71 pp.

Ignoffo, C. M., C. Garcia, M. J. Kroha, T. Fukuda, and T. L. Couch. 1981. Laboratory tests to evaluate the potential efficacy of Bacillus thuringiensis var. israelensis for use against mosquitoes. Mosquito News 41(1):85-93.

Thomas, G. D. 1981. Insect parasites of the horn fly and face fly in Missouri. pp. 118-124 in Status of Biological Control of Filth Flies. Proc. of Workshop, February 4-5, 1981, Gainesville, FL, ARS/USDA, 212 pp.

Waddill, V. H. and B. Puttler. 1980. Euplectrus puttleri established on the velvetbean caterpillar, Anticarsia gemmatalis, in southern Florida. Environ. Entomol. 9:781-782.

Ithaca, New York

Humber, R. A. 1981. An alternative view of certain taxonomic criteria used in the Entomophthorales (Zygomycetes). Mycotaxon 13:191-240.

Humber, R. A. 1981. Erynia (Zygomycetes: Entomophthorales): Validations and new species. Mycotaxon 13:471-480.

Humber, R. A. and I. Ben-Ze'ev. 1981. Erynia (Zygomycetes: Entomophthorales): emendation, synonymy, and transfers. Mycotaxon 13:506-516.

Humber, R. A., R. S. Soper, D. M. MacLeod, D. Tyrrell, R. G. Kenneth, and I. Ben-Ze'ev. 1981. Proposal to conserve the entomopathogenic fungal genus Triplosporium (Thaxter) Batko against Neozygites Witlaczil (Entomophthorales). Taxon. 30:353-357.

King, D. S. and R. A. Humber. 1981. Identification: Entomophthorales. Chapter 7, pp. 107-127 In H. D. Burges (ed.), Microbial Control of Pests and Plant Diseases, 1970-1980. Academic Press, London.

Milner, R. J. and R. S. Soper. 1981. Bioassay of Entomophthora against the spotted alfalfa aphid Therioaphis trifolii f. maculata. J. Invertebr. Pathol. 37:168-173.

Roberts, D. W. and R. A. Humber, 1981. Entomogenous fungi, pp. 201-236 In G. T. Cole and W. B. Kendrick (eds.), Biology of Conidial Fungus, Vol. 2, Academic Press, New York.

Soper, R. S. 1981. New cicada pathogens: Massospora cicadettae from Australia and Massospora pahariae from Afghanistan. Mycotaxon 13:50-58.

Soper, R. S. and D. M. MacLeod. 1981. Descriptive epizootiology of an aphid mycosis. USDA Tech. Bull. 1632.

Soper, R. S. and M. G. Ward. 1981. Production formulation and application of fungi for insect control. pp. 161-180 in G. C. Papavizas (ed.), Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Brownsville, Texas

Beegle, C. C., H. T. Dulmage, D. A. Wolfenbarger, and E. Martinez. 1981. Persistence of Bacillus thuringiensis Berliner insecticidal activity on cotton foliage. Environ. Entomol. 10:400-401.

Beegle, C. C., L. C. Lewis, R. E. Lynch, and A. J. Martinez. 1981. Interaction of larval age and antibiotic on the susceptibility of three insect species to Bacillus thuringiensis. J. Invertebr. Pathol. 37:143-153.

Dulmage, H. T. 1981. Production of bacteria for biological control of insects. pp. 129-141 In G. C. Papavizas (ed.), Beltsville Symposia in Agricultural Research, Vol. 5, Biological Control in Crop Production. Allanheld, Osmun & Co., Totowa, NJ.

Dulmage, H. T. and Cooperators. 1981. Insecticidal activity of isolates of Bacillus thuringiensis and their potential for pest control. Chapter 11, pp. 193-220, In H. D. Burges (ed.), Microbial Control of Pests and Plant Diseases, 1970-1980. Academic Press, London.

Dulmage, H. T., R. S. Soper, and D. B. Smith. 1981. The use of bacteria and fungi in insect control, pp. 112-127. In Application of Biorational Substances and Natural Enemies. Proc. 1st Japan/USA Joint Symp. on Integrated Pest Management, Tsukuba (Japan), September 29-30, 1981.

Gonzalez, J. M., H. T. Dulmage, and B. C. Carlton. 1981. Correlation between specific plasmids and delta-endotoxin production in Bacillus thuringiensis. Plasmid 5:351-365.

Krywienczyk, J., H. T. Dulmage, I. M. Hall, C. C. Beegle, K. Y. Arakawa, and P. G. Fast. 1981. Occurrence of kurstaki k-1 crystal activity in Bacillus thuringiensis subsp. thuringiensis serovar (H-1). J. Invertebr. Pathol. 37: 62-65.

Salama, H. S., M. S. Foda, A. El-Sharaby, M. Matter, and M. Khalafallah. 1981. Development of some lepidopterous cotton pests as affected by exposure to sublethal levels of endotoxins of Bacillus thuringiensis for different periods. J. Invertebr. Pathol. 38:220-229.

Yamamoto, T. and R. E. McLaughlin. 1981. Isolation of a protein from the parasporal crystal of Bacillus thuringiensis var. kurstaki toxic to the mosquito larva, Aedes taeniorhynchus. Biochem. Biophys. Res. Commun. 103:414-421.

Temple, Texas

DeLoach, C. J. 1980. Prognosis for biological control of weeds of southwestern U.S. rangelands. pp. 175-199 in Proc. V Int. Symp. Biol. Contr. Weeds, Brisbane.

DeLoach, C. Jack. 1981. Biology of a mesquite web worm, Friseria cockerelli (Busck), in central Texas. Environ. Entomol. 10:922-927.

Foster, D. E., D. N. Ueckert, and C. J. DeLoach. 1981. Insects associated with broom snakeweed (Xanthocephalum sarothrae) and threadleaf snakeweed (Xanthocephalum microcephala) in west Texas and eastern New Mexico. J. Range Manage. 34:446-454.

PRINCIPAL CONTACTS - NRP 20260

Hurlingham, Argentina -

Mr. Hugo Cordo
Acting Research Leader
Biological Control of Weeds Laboratory
1559 South Bolivar
Hurlingham
Buenos Aires, Argentina
Tel.: 011-54-1-665-0357 (Direct dial from U.S.)

Tucson, Arizona -

Dr. Harry H. Graham
Research Leader
Biological Control of Insects Laboratory
USDA, ARS, Western Region
2000 East Allen Road
Tucson, AZ 85719
Tel.: 602-327-4482
FTS: 762-6220

Albany, California -

Dr. Lloyd A. Andres
Location Leader
Biological Control of Weeds Laboratory
USDA, ARS, Western Region
1050 San Pablo Avenue
Albany, CA 94706
Tel.: 415-486-3757
FTS: 449-3757

Fresno, California -

Dr. Patrick V. Vail
Research Leader
Stored-Product Insects Research Laboratory
USDA, ARS, Western Region
5578 Air Terminal Drive
Fresno, CA 93727
Tel.: 209-487-5338
FTS: 467-5338

Newark, Delaware -

Dr. Richard J. Dysart
Research Leader
Beneficial Insects Research Laboratory
USDA, ARS, Northeastern Region
501 South Chapel Street
Newark, DE 19713
Tel.: 302-731-7330
FTS: 487-6095

Gainesville, Florida -

Dr. Gary R. Buckingham
Research Entomologist
Biological Pest Control
Research Unit
USDA, ARS, Southern Region
P. O. Box 1269
Gainesville, FL 32602
Tel.: 904-372-3505
FTS: 946-7271

Sevres, France -

Dr. B. David Perkins
Location Leader
European Parasite Laboratory
USDA, ARS
47, rue des Fontenelles
92310 - Sevres, France
Tel.: 011-33-1-534-1075 (Direct
dial from U.S.)

Tifton, Georgia -

Dr. W. Joe Lewis
Research Entomologist
Grain Insects Research
USDA, ARS, Southern Region
Georgia Coastal Plains
Experiment Station
Tifton, GA 31793
Tel.: 912-382-6904
FTS: 230-6445

Peoria, Illinois -

Dr. Clifford W. Hesseltine
Laboratory Chief
Fermentation Laboratory
USDA, ARS, North Central Region
Northern Regional Research Center
1815 N University
Peoria IL 61604
Tel.: 309-685-4011
FTS: 360-4262

Rome, Italy -

Mr. Paul H. Dunn
Location Leader
Biological Control of Weeds
Laboratory-Europe
Via Gastone Monaldi
34 - Rome, Italy
Tel.: 011-39-6-648-0140 (Direct
dial from U.S.)

Seoul, Korea -

Dr. Robert W. Carlson
Location Leader
Asian Parasite Laboratory
USDA, ARS
c/o Forest Research Institute
207, Chongyangri-2Dong
Tongdaemun-ku, Seoul
Republic of Korea
Tel.: 011-82-2-966-8969 (Direct dial from U.S.)
(As of February 1982)

Beltsville, Maryland -

Mr. Jack R. Coulson
Laboratory Chief
Beneficial Insect Introduction Laboratory
USDA, ARS, Northeastern Region
Building 417, Room 6, BARC-East
Beltsville, MD 20705
Tel.: 301-344-3185
FTS: 344-3185

Dr. Lloyd V. Knutson
Chairman
Insect Identification and Beneficial Insect Intro. Inst.
USDA, ARS, Northeastern Region
Building 003, Room 1, BARC-West
Beltsville, MD 20705
Tel.: 301-344-3182
FTS: 344-3182

Dr. James L. Vaughn
Laboratory Chief
Insect Pathology Laboratory
USDA, ARS, Northeastern Region
Bldg. 011-A, Room 214, BARC-West
Beltsville, MD 20705
Tel.: 301-344-3688
FTS: 344-3688

Dr. Raymond Rebois
Laboratory Chief
Nematology Laboratory
USDA, ARS, Northeastern Region
Building 011A, Room 165, BARC-W
Beltsville, MD 20705
Tel.: 301-344-3660
FTS: 344-3660

Frederick, Maryland -

Dr. William L. Bruckart
Research Plant Pathologist
Plant Disease Research Laboratory
USDA, ARS, Northeastern Region
P. O. Box 1209
Frederick, MD 21701
Tel.: 301-663-7344
FTS: 935-2632

Stoneville, Mississippi -

Dr. Edgar G. King, Jr.
Laboratory Chief
Bioenvironmental Insect Control Laboratory
USDA, ARS, Southern Region
P. O. Box 225
Stoneville, MS 38776
Tel.: 601-686-2311
FTS: 497-2231

Columbia, Missouri -

Dr. Carlo M. Ignoffo
Research Leader
Biological Control of Insects Research
USDA, ARS, North Central Region
P. O. Box A
Columbia, MO 65205
Tel.: 314-442-2271
FTS: 276-3194

Ithaca, New York -

Dr. Richard S. Soper
Research Leader
Insect Pathology Research Unit
USDA, ARS, Northeastern Region
Boyce Thompson Institute
Cornell University, Tower Road
Ithaca, NY 14853
Tel.: 607-257-2030
FTS: 882-4228

Brownsville, Texas -

Dr. Howard T. Dulmage
Research Leader
Cotton Insects Research
USDA, ARS, Southern Region
P. O. Box 1033
Brownsville, TX 78520
Tel.: 512-542-2516
FTS: 734-8214

Temple, Texas -

Dr. C. Jack DeLoach
Research Entomologist
Grassland, Soil and Water
Research Laboratory
USDA, ARS, Southern Region
P. O. Box 748
Temple, TX 76501
Tel. 817-774-1201
FTS: 736-1201

National Research Program 20270

CROP DISEASE CONTROL AND NONCOMMODITY RESEARCH ON PLANT PATHOGENS AND NEMATODES

This National Research Program includes basic research on plant disease and nematode problems, regardless of commodity. Scientists provide the in-depth fundamental knowledge that is used in applied research programs aimed at preventing or controlling diseases and nematode attacks. They study the nature of resistance to pathogens and nematodes and how damage is caused and develop new methods for disease/nematode control or management. By means of team effort, research is designed for the development of systems that will reduce crop losses through the use of combinations of resistant varieties, biological control, cultural practices, and minimum use of chemicals.

NPS Contact: H. E. Waterworth

Technological Objective 1: Acquire fundamental knowledge and develop basic concepts relative to plant diseases, nematodes, and causal agents.

Research Locations:

Berkeley, California
Miami, Florida
Brookings, South Dakota
College Station, Texas
Pullman, Washington
Madison, Wisconsin

Technological Objective 2: Develop systems that will provide economical control of plant diseases and nematodes and have maximum beneficial effects on yields and quality and minimum undesirable effects on the environment and public health.

Research Locations:

Salinas, California
Mayaguez, Puerto Rico
Jackson, Tennessee
Prosser, Washington

Research locations that address both Technological Objectives:

Davis, California
Shafter, California
Orlando, Florida
Byron, Georgia
Tifton, Georgia
Urbana, Illinois
Baton Rouge, Louisiana
Beltsville, Maryland
Frederick, Maryland
St. Paul, Minnesota
Bozeman, Montana
Ithaca, New York
Corvallis, Oregon
Charleston, South Carolina
Lubbock, Texas
Weslaco, Texas
Logan, Utah
Kearneysville, West Virginia

Following are some examples of recent progress:

Bacterial antagonists of soil-borne fungal pathogens of cotton and potato obtained from crop roots and from cropped desert soils - Davis, California. Several bacteria that are very antagonistic to major soil-borne fungal pathogens of potatoes, wheat, and cotton were isolated from the roots of those crops and from cropped desert soils. Most of the highly antagonistic bacteria belong to the spore-forming genus Bacillus. Some of the antagonists restricted the growth of all major root-infecting fungi of cotton and potato. Determining how to increase the population of certain antagonists on crop roots by cultural practices or by genetic changes in crop cultivars, or both, along with the use of antagonist bacteria, might provide additional means of controlling some of the major pathogens in cotton and potatoes, as well as in other crops.

Strains of Verticillium fungus carried by alfalfa seed found to be damaging to other crops - Davis, California. Earlier thinking was that fungus carried in alfalfa seed was a weak pathogen in alfalfa and posed no threat of losses. However, studies indicated that 'Lahontan' alfalfa is moderately susceptible to V. dahliae obtained from alfalfa seed produced in Washington. Furthermore Southeastern cotton cultivars were severely affected by the fungus, which was also mildly pathogenic in the 'Early Pak' tomato. Although it is not yet certain that V. dahliae poses a problem for alfalfa, strains of V. dahliae that were found to be pathogenic in other crops are being carried on alfalfa seed.

Some U.S. breeding lines of hybrid sugarbeet found to be highly susceptible to a Netherlands nematode--Heterodera trifolii - Salinas, California. These studies revealed that many agricultural crops are vulnerable to attack by this foreign nematode. The studies provided information that will be much needed should the nematode become established in the United States. In screening tests, a few interspecific hybrid beet plants were found to be immune to the yellowbeet cyst nematode. Results established that all breeding lines of the interspecific hybrid Beta vulgaris-procumbens are not resistant to H. trifolii. However, two plants that appear to be immune may have usable resistance that can be incorporated into cultivars of sugarbeet. Continued genetic investigations of these plants as a cooperative project with Dutch nematologists and breeders are planned.

Nematode-resistant citrus rootstock identified - Orlando, Florida. Greenhouse and field evaluations have indicated that Swingle citrumelo (Citrus paradisi Macf. X Poncirus trifoliata (L.) Raf.) is resistant to citrus nematode (Tylenchulus semipenetrans Cobb) populations commonly found in Florida citrus groves. Swingle citrumelo reduced citrus nematode populations to nondetectable levels within 2 years under field conditions. In greenhouse studies, citrus nematode populations were significantly reduced by Swingle citrumelo seedlings within 2 months of inoculation. Resistance was correlated with lower numbers of nematodes becoming associated with the rhizoplane and infecting feeder roots. Citrus nematode infection of Swingle citrumelo resulted in a hypersensitive-type response in the root hypodermis accompanied by wound periderm formation.

Nematode-nematode antagonism in citrus groves found to limit pathogen distribution - Orlando, Florida. The distributions of Pratylenchus coffeae and Tylenchulus semipenetrans in a central Florida grove were mutually exclusive. In a challenge experiment conducted in the grove, indigenous populations of either species did not preclude infection by the other species. Inoculation with either T. semipenetrans or P. coffeae tended to reduce the population size of the other nematode species. In greenhouse tests, individual feeder roots were parasitized predominantly by one or the other of the two species. Host response to parasitism in dual infections did not differ from response to single infection by either species. Findings suggest that P. coffeae is a poor competitor and, therefore, may not be as significant a threat to the Florida citrus industry as had been speculated previously.

Fumigation found to control Criconomella xenoplax and to increase 'Redglobe' peach yields when used in combination with drip irrigation - Byron, Georgia. The interaction of fumigation (DBCP) and drip irrigation (FxI) for 1977-1980 had probabilities of 12% for the four year total. In 1978 the increased yield by this interaction increased the calculated gross income by $800/acre. The interaction was attributed to increased health of the roots (unmeasurable) of fumigated trees that allowed them to absorb more water than could roots with high populations of C. xenoplax. By 1981, irrigation increased yields only by 59 bu/acre (gross income by $586/acre) but the increase was not statistically significant. Apparently the DBCP, applied in November 1976 and December 1977, had lost its effectiveness on the nematode by the 1981 season. Nematode populations were back to about the same as in the nonfumigated plots. The build-up of C. xenoplax populations and loss of significant interaction is further evidence that roots injured by nematodes are unable to take up as much water as are healthy roots. It also shows the importance of C. xenoplax control, for which DBCP has been effective.

Nematicides found to increase corn and soybean yields in double-crop culture system - Tifton, Georgia. Yields of corn planted by the rip-plant method and of soybeans planted on a moldboard-prepared seedbed in a double-crop culture system were increased an average of 30.3 and 14.0 bu/acre, respectively, by nematicide application. The application of nematicides to the previous crop of soybeans caused no residual effects on yield of corn, soybeans, but Nemacur and Temik applied to corn increased yields of the succeeding crop of soybean 10.2 bu/acre and 6.2 bu/acre, respectively. Gross returns per acre for nematicides applied to these crops based on corn at $2.50/bu and soybean at $6.00/bu were $75.75 and $84.00, respectively, or a total of $159.75.

Nematicides increase soybean yields in a small grain-soybean double-crop culture system - Tifton, Georgia. Yields of GaSoy 17 soybean grown in a double-crop culture following rye and wheat and treated with ethylene dibromide at 10.9 kg ai/acre and Temik at 0.9 kg ai/acre were increased by 13.4 bu/acre and 8.0 bu/acre, respectively. Nemacur at 0.9 kg ai/acre did not increase yields significantly. These results indicate that ethylene dibromide is a much superior nematicide than the nonfumigant type nematicides.

Root-knot nematodes suppressed by crop rotation - Tifton, Georgia. Population densities of root-knot nematodes (Meloidogyne incognita) were suppressed to

below damaging levels in a sweet corn-sweet potato-vetch intensive cropping system (ICS); but M. incognita and M. hapla increased rapidly on lima bean and peanut, respectively, in field corn-lima bean-vetch and tomato-peanut-wheat ICS. The former ICS will reduce the need for a nematicide/pesticide residue in the soil, and the cost of nematode control (up to $40/acre for each crop).

Resistance to root-knot nematodes in Nemagreen lima bean is not adequate to prevent large crop losses in intensive cropping systems - Tifton, Georgia. Yield of lima bean in a field corn-lima bean-vetch cropping system was increased 62% following application of phenamiphos (2.7 kg ai/acre) to control root-knot nematodes (M. incognita). Planting 'Nemagreen' in intensive cropping sequences in fields where M. incognita is present will increase numbers of nematodes and could result in a complete crop loss (approximately $400/acre) if a nematicide is not used.

Nematicide applied through an irrigation system reduced damage on tomato transplants and on peanuts in an intensive cropping system - Tifton, Georgia. Metham (VAPAM) applied at 192 L/acre through a sprinkler irrigation system immediately after seeding reduced damage caused by root-knot nematodes (M. arenaria and M. hapla) on tomato transplants and on a succeeding crop of peanuts and increased peanut yield 50% over that from nontreated control plots. Currently, this practice is not economically feasible for nematode control on most crops.

Phenamiphos applied through a sprinkler irrigation system controlled nematodes and increased yield of squash and field corn - Tifton, Georgia. Phenamiphos was applied (2.7 kg ai/acre) to squash and field corn via injection into a sprinkler irrigation system. Nematode control and yield results from use of this application method were compared with those from use of the conventional method, with which the nematicide granules were spread on the soil surface and incorporated into the top 15-cm layer of soil. These methods were equally effective in crop response, yield increase, and nematode control. Yields of squash and corn from treated plots were 325% and 149% greater, respectively, than those from untreated plots. These data will result in (a) application of selected nematicides through irrigation to optimize nematode control and increase yields 20% or more in multiple-cropping production systems, (b) a 40% or greater reduction in the cost of nematicide application as compared with the cost of conventional methods, and (c) increased human safety through utilization of closed pesticide application systems.

Nematicide applied through a sprinkler irrigation system found to cause no soil/water pollution problem - Tifton, Georgia. Phenamiphos was applied (2.7 kg ai/acre) via injection into a sprinkler irrigation system with 0.25 and 2.0 cm of water/acre, and concentrations resulting from use of this method were compared with the concentrations resulting from use of the conventional method, in which nematicide granules were spread on the soil surface and incorporated into the top 15-cm layer of soil. In the 0- to 15-cm soil layer, phenamiphos concentrations 7 days after application were near or below 1 ppm, compared with 1.8 ppm for the conventional method of application. In the 15- to 30-cm soil layer, phenamiphos concentrations were <1.0 ppm on all sampling dates.

New soybean variety resistant to the soybean cyst nematode released - Urbana, Illinois. Fayette, a Maturity Group III soybean that is resistant to races 3 and 4 of the soybean cyst nematode (SCN), was released through the cooperative effort of USDA-ARS and Illinois, Missouri, and Kentucky State Agricultural Experiment Stations. Fayette approaches Williams-79 in performance and will result in reduced SCN losses in the northern areas of the United States where no SCN-resistant varieties of adaptable maturity were previously available. Results of a survey in a single Illinois county infested heavily with SCN indicated that the growing of soybean varieties resistant to only race 3 of SCN, and with less yield potential than Fayette, resulted in increased yields of 8 bu/acre (64,000 for the county). With the increased yield potential and resistance to both races 3 and 4 found in Fayette, its production in the more than 100 SCN-infested counties in the region where it can be grown should ensure even greater yield increases.

Nematicide applied in transplant water found to provide improved control of sweetpotato nematodes - Baton Rouge, Louisiana. Oxamyl (VYDATE) applied in transplant water gave effective sweetpotato nematode control in field applications. Oxamyl applied at a low dosage increased the No. 1 grade 14, 'Canners 42', and total marketables by 56 bu/acre. If registered this material and new control methods offer the potential for a cost effective treatment for sweetpotato use.

Nine wheat varieties found to be resistant to root-knot nematode - Baton Rouge, Louisiana. Nine wheat varieties adaptable to the Southern United States were found to be highly resistant to the root-knot nematode, Meloidogyne incognita. Wheat acreage is increasing rapidly in the South in a double cropping system with soybeans. Use of wheat varieties that are resistant to root-knot nematode will preclude the buildup of nematodes and their subsequent damage to soybeans and other crops.

Cotton germplasm found that is resistant to the reniform nematode - Baton Rouge, Louisiana. No commercial cotton with resistance to reniform nematode (RN) was previously known. Cooperative research with Dr. C. P. Yik indicated that Gossypium longicalyx was immune to RN, whereas G. stocksii, G. somalense, and G. barbadense 'Texas 110' are highly resistant. Other cotton lines resistant are G. hirsutum race 'Marie Galante'; G. arboreum PI 417895, PI 417891, and CB 3839; and G. herbaceum PI 408775. Plant breeders now have germplasm from which to develop commercial varieties that are resistant to the reniform nematode.

Monoclonal antibody serological procedure developed to aid in plant virus diagnosis and taxonomy - Beltsville, Maryland. Procedures were developed for the production of hybridoma mouse cells that produce highly specific antibodies to four plant viruses. All were of high titre and quality. Hybridomas possess the features of constant antibody quality for an almost indefinite period. The antibodies to the viruses rose mosaic, apple mosaic, Prunus ringspot and alfalfa mosaic were used in the sensitive ELISA test and permitted detailed studies on virus relationships (E. Halk, American Type Culture Collection).

Sensitive and practical new test developed to detect viroids - Beltsville, Maryland. A sensitive test was developed for large-scale applied detection of

the potato spindle tuber viroid (PSTV). Genetic engineering technology was used for production of DNA complementary to the PSTV. Small samples of seed potato eyes or even a piece of potato peel, provide sufficient material for hybridization with PSTV cDNA made radioactive with phosphorus. This rapid diagnostic test will become extremely valuable in the production of PSTV-free seed potatoes.

An artificial medium developed for growing plant spiroplasmas - Beltsville, Maryland. A precisely defined medium, especially for lipids, has been developed that will allow the culturing of spiroplasmas and the identification and culturing of new isolates. This finding may lead to the development of other media for culturing other mycoplasma-like organisms. Knowledge of the lipid requirements of spiroplasmas may provide a means for their control through the selection of crop plants that do not produce all the lipids required by these pathogens.

Three major nematodes cultured on artificial media - Beltsville, Maryland. Successful cultures were developed for the soybean cyst nematode; Heterodera glycines races 3, 4, and 5; the corn cyst nematode, Heterodera zeae; and the reniform nematode, Rotylenchulus reniformis. Detailed studies of the host-parasite interactions of these nematodes can now be done in the laboratory under controlled environmental conditions. These culture techniques will also permit secure handling of economically dangerous nematode pests in uncontaminated geographic regions. Growth of these nematodes under gnotobiotic conditions will be beneficial to private and public plant breeders and to geneticists and nematologists in selecting for resistance. Studies on the biology, physiology, and biochemistry of these nematodes and the nature of resistance to them will be expedited.

A "new" corn nematode found in the United States - Beltsville, Maryland. A serious root pest of corn was identified for the first time in Maryland in 1981. Identification of Heterodera zeae, the corn cyst nematode, was made on cysts collected from four corn fields on Maryland's Eastern Shore. Previously, this nematode was known to exist only in India, Pakistan, and Egypt and is of economic importance. It parasitizes not only all corn varieties tested, but also wheat, oats, and barley. In response to the threat posed by H. zeae to corn production in the United States and as a segment of a larger cooperative USDA-Maryland research effort, taxonomic research on this and related cyst species was completed in 1981. A comprehensive taxonomic publication is forthcoming. Data on distribution and diagnosis of 30 other cyst species that exist in the United States and Canada are included, along with illustrated keys for the identification of all these species. This research provides the basic knowledge needed for accurate and prompt identification of this important group of nematodes.

New fungal parasite of the soybean cyst nematode found in the United States - Beltsville, Maryland. The fungus Nematophthora gynophila has been identified for the first time in the United States in cooperative work with scientists in Jackson, Tennessee and in Rothamsted, England. This fungal parasite attacks the adult stage of the soybean cyst nematode. In England this fungus functions as a biocontrol agent of the oat cyst nematode. Work continues on its effectiveness as a nematode control agent.

Monograph of Monilinia published - Beltsville, Maryland. A monograph of recently completed indepth research on all species of Monilinia, the fungus responsible for brown rot of orchard fruits and mummy berry disease of blueberries and cranberries, has been published. The research included 3 years of field screening for disease resistance in all of the 216 selections of peaches grown at Beltsville and observations of diseased host plants in the Eastern United States and in Europe and Japan, as well as study of herbarium material from all major areas of the world. Not only were conclusions reached in regard to the classification or taxonomy of species, but also an understanding was gained of many biological characteristics that determine development and pathogenicity of the various species, distribution, host susceptibility, and other attributes significant for disease control.

First comprehensive inventory of the large fungi in Grand Teton and Yellowstone National Parks completed - Beltsville, Maryland. Nearly 500 species and varieties of mushrooms and other conspicuous fungi were found during ecological and distributional studies in the Grand Teton and Yellowstone National Parks and environs. The collections were obtained for a study of fungus distribution and ecology in the Rocky Mountains; some are from snow banks and other special ecological situations at high elevations of the mountains. Most were collected from the soil surface or from dead wood or standing trees. Since an inventory of fungi in the two parks has never been published, a list was prepared and will be issued in a bulletin as the first comprehensive record of the large fungi in this area of the country. The record will be available for use in the two parks.

New spore form of the fungus Trichoderma found that will enhance its value as a biocontrol agent - Beltsville, Maryland. Chlamydospores, the ecological importance of which has not been known, may be more important than conidia in enhancing the value of the fungus Trichoderma as a good biocontrol agent. Results of a study conducted by ARS indicated that chlamydospores are formed in large numbers in a wide variety of liquid and solid media by most isolates of Trichoderma. These resistant propagules survive better in the environment than do the ephemeral conidia. Production of large numbers of chlamydospores increases its value as a biocontrol agent because chlamydospores will survive longer in storage and in the soil.

Newly discovered soil fungus found to suppress Verticillium wilt of eggplant - Beltsville, Maryland. A fungus, Talaromyces flavus, considerably suppressed Verticillium wilt disease of eggplant in the field. Field application of the beneficial fungus alone or together with sublethal amounts of the fumigant TELONE 17 (27 L/acre instead of the 115 L/acre recommended on the label), gave as good control of Verticillium wilt (and increased yield) as the recommended high rate of the fumigant used alone. This discovery is important because (a) it offers the possibility for reducing losses, caused by Verticillium, to other crops (potato, cotton), and (b) it opens the way to a new integrated pest management system whereby growers can obtain economic control of an important disease with one-fourth the label-recommended rate of this fumigant.

Induced beneficial fungus found to reduce Fusarium wilt disease of chrysanthemums - Beltsville, Maryland. An ultraviolet light-induced biotype of the beneficial fungus Trichoderma was found to be resistant to the fungicide benomyl and to reduce Fusarium wilt disease of chrysanthemum by 75% when it was added to freshly steamed soil in greenhouse production procedures. Steaming alone does not prevent this serious disease. The procedure is readily adaptable to production practices and will result in a considerable decrease in disease and in the need for fungicides. In addition, this benomyl-resistant biocontrol agent will allow continued use of benomyl to control foliar diseases, without adversely affecting the efficacy of the biocontrol agent.

Improved media for fungus biocontrol agent developed and patented - Beltsville, Maryland. Excellent growth and sporulation of the beneficial fungus parasite, Sporidesmium sclerotivorum, was obtained in liquid media that were developed as a result of nutritional studies. Improved and predictable high yields of spores and mycelium were obtained by modifying previous media with calcium, iron, and a pH buffer. This accomplishment advances mass cultivation technology for the use of S. sclerotivorum as an applied biocontrol agent of Sclerotinia diseases. A U.S. Patent covering the cultivation and use of this fungus was issued to the Department of Agriculture. This patent indicates the potential importance and utility of this mycoparasite as a biocontrol agent and will permit licensing of industrial firms for development of biocontrol technology.

Application of pesticide through irrigation system found to reduce rate necessary for disease control - Beltsville, Maryland. A new method was developed for applying an old pesticide at reduced rates. The method will allow lettuce farmers to greatly increase production at a modest cost for the pesticide. For 2 years, field tests have indicated that metham (VAPAM), when applied through an irrigation system at one-third to one-fourth of the recommended rate provided 90% control of lettuce drop disease. Savings to the farmers will be realized in terms of dollars, energy, and labor.

Soil from ancient Mexican agricultural systems found to suppress soilborne diseases - Beltsville, Maryland. Two important diseases caused by the fungi Pythium and Rhizoctonia were naturally suppressed in soils from agricultural systems originally used by the ancient Aztecs and Mayas in Mexico. Isolation of microorganisms from these soils yielded a bacterium and several fungi that are antagonistic to soilborne pathogens and have potential as biocontrol agents.

Compounds found that stimulate fungal spore germination; others that stimulate or inhibit weed seeds - Frederick, Maryland. Seven of 18 species of weed seed were stimulated to germinate by 8 of 12 chemicals tested. Others inhibited seed germination of several major weed species, at all concentrations of chemicals tested. Another group of compounds stimulated fungal spores of curly dock, sunflower and cowpea rust fungi to germinate, the latter before the spores were released from the pustules. This technology has potential to control these weeds and fungi by upsetting germination.

New potential problem for corn production identified - Frederick, Maryland. A fungus which causes corn ear- and stalk rot, Diplodia macrospora, is commonly found in Mexico and Central America, but has been limited to the southernmost areas of the U.S. cornbelt. However, with increasing use of minimum tillage,

this pathogen has been observed spreading northward. Greenhouse studies indicatd that D. macrospora is more aggresive than is the widespread D. maydis in attacking corn at early stages of growth.

Resistance to soybean rust disease found - Frederick, Maryland. Genetic studies indicated that specific resistance to soybean rust in each of three soybean accessions is controlled by a different single gene in each accession. Knowledge of the genetics of specific resistance is essential to the rational development of rust-resistant varieties. Resistance was found in two soybean cultivars from China, PI 459024 and PI 459025, and in a Korean accession of Glycine soja (wild soybean, cross compatible with Glycine max) PI 339871. The resistance in PI 459025 is significant because it is effective against an array of rust pathotypes from six countries. As a result of this research, six sources of specific resistance to rust are now available to breeders.

Disease epidemics generated on computer simulator - Frederick, Maryland. A series of plant disease epidemics were generated on a previously validated computer simulator. Predicted disease intensities were as sensitive to the shape of the host growth curve as to the changes in temperatures and moistures. The changes in disease intensity, in response to growth of the host, underscores the importance of having accurate representative host growth models for development of accurate simulated disease progress curves.

A fungal bioherbicide has potential to cause natural epidemics on dock weeds - Frederick, Maryland. Natural infections of the fungus Ovularia on wild dock plants (Rumex) occurred very early so that three infection cycles had been completed by early April. Despite low overwintering inoculum and slow spread from established infections, Ovularia begins early enough to cause natural epidemics in most years. To the degree that the amount and distribution of fungus can be bolstered by early inoculations (i.e., as a bioherbicidal treatment), earlier and more severe epidemics on Rumex should result.

Computer program developed to assist in cereal rust research - St. Paul, Minnesota. A computer based system (IRIS) was developed for comparing infection types produced by the interaction of cultures of Puccinia graminis on cereal hosts with designated resistance genes and for postulating the rust-resistance genotype of cultivars of unknown resistance. IRIS sorts races of the pathogen and permits the user to compare infection types produced by all previously evaluated cultures on 45 "single" gene resistant isolines with the infection types produced by newly evaluated cultures on the same 45 host genes. Infection-type data from new cultures can be added to the system, as well as infection-type data for host resistances new to the system. The infection types from selected cultures were used to postulate host-resistance genotypes without the necessity of time-consuming genetic studies.

Leaf rust-resistant, white-flour wheat developed through breeding and irradiation - St. Paul, Minnesota. F_2 embryos of the cross Agatha/Morocco were subjected to gamma irradiation, and leaf-rust-resistant plants were selected in the F_2 and F_4 generations. From about 2,400 such resulting lines, 71 lines of F_5 embryos were found whose carotene content was equal to or only slightly greater than that of the low-carotene cultivar Morocco. These

are now being retested for rust resistance and white flour color. Some of these lines should provide "universal leaf-rust resistance," conditioned Lr 19 combined with suitable non-yellow flour.

Oat hybrids provide new combined resistance to crown and stem rusts - St. Paul, Minnesota. Progeny of noncultivated Avena species have new combined resistance to crown and stem rust. These lines with recombinations of resistance genes from the lower-ploidy oat species possess near immunity to the prevalent races of the crown rust and stem rust pathogens. This union of resistance genes from several species offers the possibility of a more enduring type of rust resistance than that previously available to oat breeders.

Effects of powdery mildew infection on barley plant cells determined - St. Paul, Minnesota. Powdery mildew infection causes pronounced changes in cell membranes in susceptible barley. Membranes were altered in two ways: permeability to methylurea was reduced, and attachment of the membrane to cell walls was increased. These changes provide new insight into the way pathogens are able to extract nutrients from infected tissues without killing them.

Resistant wheat lines from the ARS Septoria Disease Nursery were widely used by breeders in 1981 - Bozeman, Montana. The USDA International Septoria Nursery, established in 1972 to test and disseminate wheats that are resistant to Septoria nodorum and S. tritici, is used in most parts of the world where Septoria diseases of wheat are important. A survey conducted in 1981 revealed that germplasm from the nursery was used in wheat cultivar development programs in ten states of the United States and in eleven other countries. In Rio Grande do Sul, Brazil, where environmental conditions are favorable for diseases, the USDA nursery was the only international collection that had several (12) disease-resistant entries in 1981.

Systems developed for management of golden nematode under field conditions - Ithaca, New York. In systems that included growing golden-nematode-resistant cultivars of potatoes and nonhost alternate crops and using minimal nematicides, densities of golden nematode were suppressed to levels below which it does not spread. In 1981, potato growers in Steuben County, New York, chose to adopt these nematode management systems in lieu of instituting a quarantine. This choice was sanctioned by USDA and by New York State regulatory officials. This research successfully aided regulatory efforts.

Beneficial effect of mycorrhizal fungi in container plant production enhanced by addition of other components to potting mixes - Corvallis, Oregon. Critical studies on soilless potting mixes and/or their components indicated that infection and plant-growth enhancement by VA mycorrhizal (VAM) fungi is greatly reduced in media that have no ingredient to bind phosphorous, which inhibits VAM. The addition of soil, sand, terface, and bentonite clay to sphagnum peat nullified the inhibitory effect of peat caused by its lack of P-binding capacity. Hypnum peat bound P effectively and favored VAM activity. Use of the findings from this research will improve the beneficial effect of VAM in the container production of plants.

Partial success attained in crossing unrelated plant species - Charleston, South Carolina. The problem of inability to cross unrelated plant species--each with desirable traits--has been partially overcome. Cells from leaves of wild potato and eggplants placed in a mixture of cell-wall-degrading enzymes were stripped of their walls by the mixture. The resulting protoplasts from the two plants were fused with a high-molecular-weight polyethylene glycol (PEG). The resulting product formed a common cell wall and entered into cell division to form a colony of cells. This colony would have been the progenitor of a hybrid plant if the cells had not died before they could be induced to regenerate whole plants. This method for producing new plants has the potential for transferring desirable traits, such as disease resistance, from one plant species to another susceptible plant species when neither would ordinarily fertilize the other by conventional methods.

Chemicals and management practices control nematodes in cotton - Lubbock, Texas. In experiments designed to obtain data on cotton losses caused by the root-knot nematode, Meloidogyne incognita, it was shown that cotton yields were increased 30% where ethylene dibromide was applied to control this nematode. After 60 days, nematode populations were reduced by a factor of 10 over the control. Over 50% of the cotton acres in the area contain populations of root-knot nematodes. Extrapolating these data support previous research that shows a 10% annual cotton loss to nematodes on the Southern High Plains of Texas. Forty-eight advanced breeding lines of cotton were evaluated for resistance to root-knot nematodes and to Verticillium wilt. Thirty were selected for further evaluation.

Nematode-fungus interaction found to increase seedling disease of muskmelon - Weslaco, Texas. A complex of the nematode, Rotylenchulus reniformis, and the fungus, Rhizoctonia solani, was discovered that will give insight into the physiology of pathogen complexes. When both the nematode and fungus were present, six times as many seedlings were diseased as when the fungus alone was present. Since the nematode parasitizes roots and the fungus parasitizes hypocotyls, the nematode does not provide wound sites for fungal entry. Thus, the nematode must alter the chemical composition of the muskmelon to lower seedling resistance to the fungus.

Nonregistered nematicides found to increase sugarbeet yields as much as 63% - Logan, Utah. In microplot studies, nonregistered terbufos was found to be effective in controlling the sugarbeet cyst nematode. Sugarbeet yields were increased by 42 and 63% over those of nontreated controls, with 4.5 (ai) and 8.0 (ai) kg/ha of terbufos, respectively. This compared to an increase of 63% over those of nontreated controls with 4.5 (ai) kg/ha of aldicarb. In another study ethylene dibromide increased sugarbeet yields over those of nontreated controls by 187 and 299% at rates of 10 to 15 (ai) kg/ha, respectively. This compared to increased sugarbeet yields over those of nontreated controls of 266 and 315% at rates of 124 and 155 (ai) kg/ha of 1,3-dichloropropene.

Damage by the sugarbeet cyst nematode can be forecast by heat unit per day - Logan, Utah. The rate of reproduction of the sugarbeet cyst nematode (Heterodera schachtii) can be determined regardless of soil temperature by using a heat unit/day criterion. This allows growers to determine the rate of

increase of the nematode population and to forecast the degree of pathogenicity and crop yield. This criterion may be applicable to other plant nematode systems. By comparing the relationships of different nematode populations to different populations of weed hosts, it also showed that different pathotypes of H. schachtii exist which must be considered in an effective sugarbeet breeding program.

Sclerotinia wilt and Fusarium root rot diseases in beans largely controlled by integrated management - Prosser, Washington. Sclerotinia wilt disease in three varieties of dry beans was largely controlled by reducing either frequency or volume of sprinkler irrigation. Further, where strong-rooting, root-rot-resistant beans were grown in subsoiled (loosened, not compacted) plots of sandy loam soil, optimum yields of high-quality beans were produced under irrigation regimes that controlled Sclerotinia wilt and conserved water and energy. Fusarium root rot was also controlled by integrated use of Fusarium-resistant beans, with efficient tillage and irrigation management.

Bacteria found that control wheat "take-all" fungus disease - Pullman, Washington. Several strains of a Pseudomonas bacterium were highly effective in suppressing the serious "take-all" disease of the Northwest wheat crop. Applied as a seed treatment, the bacteria multiply on the roots of young plants and can be detected throughout the growing season. Bacterial populations were greater on roots in soil where the fungus pathogen was present than on roots in soil free of the pathogen. Industry has exhibited considerable interest in commercializing this disease control method.

Nematode species found in orchard tree cankers - Kearneysville, West Virginia. Species of Aphelenchoides nematodes were found on tree cankers normally attributed to various fungi. Among the fungi/tree cankers from which these nematodes were found are: Botryosphaeria on apples, Cytospora on cherries and peaches, and Endothia on American chestnut. This discovery may help to elucidate the cause of tree cankers--the role that nematodes and fungi--and even viruses--play in destructive cankers.

Messenger RNA's transcribed from the bacterium into sunflower tumors in genetic engineering research - Madison, Wisconsin. At least seven messenger RNA's (mRNA's) were transcribed from the crown gall bacterium (Agrobacterium) into crown gall tumor of sunflowers. The size and relative amounts of the transcripts were determined. The mRNA that causes tumors was among those that were removed.

P U B L I C A T I O N S

Davis, California

Schnathorst, W. C. 1981. Life cycle and epidemiology of Verticillium. In Fungal Wilt Disease of Plants. M. Mace, A. A. Bell, and C. Beckman (eds.). Academic Press, NY Publishers, Chap. 4, pp. 81-111.

Schnathorst, W. C. 1981. Verticillium wilt. In A compendium of Cotton Diseases. G. M. Watkins (ed.) American Phytopathological Society, publishers, pp. 41-44.

Orlando, Florida

Kaplan, D. T. 1981. Characterization of citrus rootstock responses to Tylenchulus semipenetrans (Cobb). J. Nematol. 13:492-499.

Byron, Georgia

Horton, B. D., E. J. Wehunt, J. H. Edwards, R. R. Bruce, and J. L. Chesness. 1981. The effects of drip irrigation and soil fumigation on 'Redglobe' peach yields and growth. J. Am. Soc. Hort. Sci. 106:438-443.

Tifton, Georgia

Adamson, W. C. and N. A. Minton. 1981. Stem root density in kenaf and roselle at different harvest dates. Crop Sci. 21:849-851.

Hauser, E. W., G. A. Buchanan, J. E. Harvey, W. L. Currey, D. W. Gorbet, and N. A. Minton. 1981. Pesticide interactions with peanut cultivars. Peanut Sci. 8(2):142-144.

Jaworski, C. A., S. C. Phatak, A. W. Johnson, and S. M. McCarter. 1981. Tomato production and soil pest control in relation to width of fumigated and mulched bed and soil fumigation rate. Hort. Sci. 16:667-669.

Johnson, A. W. 1981. Application of nematicides through an overhead sprinkler irrigation system for control of nematodes on crops. Proc. of the National Symposium on Chemigation, pp. 898-95.

Johnson, A. W., C. A. Jarowski, N. C. Glaze, D. R. Sumner, and R. B. Chalfant. 1981. Effects of film mulch and soil pesticides on nematodes, weeds, and yields of vegetable crops. J. Nematol. 13(2):141-148.

Johnson, A. W., J R. Young, and B. G. Mullinix. 1981. Applying nematicides through an overhead sprinkler irrigation system for control of nematodes. J. Nematol. 13:154-159.

Minton, N. A., and D. K. Bell. 1981. Effects of chemicals, applied before and after planting, on nematodes and southern stem rot of peanuts. Plant Disease 65:497-500.

Minton, N. A., D. K. Bell, and A. S. Csinos. 1981. Effects of nematicides applied at planting and postplant on peanut yields, root-knot nematodes, and white mold. Proc. Amer. Peanut Res. and Ed. Soc., Inc. 13:93.

Urbana, Illinois

Edwards, D. I., and G. R. Noel. 1981. Update: Soybean cyst nematode. Ill. Res. 23:4-5.

Baton Rouge, Louisiana

Heald, Charles M., W. Birchfield, C. W. Blackmon, R. S. Hussey, C. C. Orr, R. L. Shepherd, J. Veech, and F. Smith. 1981. Nematodes. In Compendium of Cotton Diseases. Amer. Phytopath. Soc., p. 50-56.

Williams, C. D., D. F. Gilman, D. S. Fontenot, and W. Birchfield. 1981. Inheritance of reaction to the reniform nematode in soybean. Crop Sci. 21:93-94.

Yik, Choi-Pheng, and W. Birchfield. 1981. Observations on the morphology of the pinewood nematode, Bursaphelenchus xylophilus. J. of Nematol. 13:376-384.

Beltsville, Maryland

Adams, P. B., and W. A. Ayers. 1981. Sporidesmium sclerotivorum: Distribution and function in natural biological control of sclerotial fungi. Phytopathol. 71:90-93.

Andrews, S., L. R. Krusberg, and A. M. Golden. 1981. Host range, life cycle, and host-parasite relationships of Meloidoderita sp. Nematologica 27:146-159.

Ayers, W. A., and P. B. Adams. 1981. Biological control system. U.S. Patent 4,246,258. U. S. Dept. of Agr.

Ayers, W. A., and P. B. Adams. 1981. Mycoparasitism of sclerotial fungi by Teratosperma oligocaldum. Can. J. Microbiol. 27:886-892.

Ayers, W. A., and P. B. Adams. 1981. Mycoparasitism and its application to biological control of plant diseases. Chap. 6. In G. C. Papavizas (ed.), Biological Control in Crop Production. Beltsville Symp. Agr. Res. Vol. 5. Allenheld, Osmun Co.

Ayers, W. A., E. A. Barnett, and P. B. Adams. 1981. Germination of macroconidia and growth of Sporidesmium sclerotivorum in vitro. Can. J. Microbiol. 27:664-669.

Barnett, E. A., and W. A. Ayers. 1981. Nutritional and environmental factors affecting growth and sporulation of Sporidesmium sclerotivorum. Can. J. Microbiol. 27:685-691.

Davis, R. E., T. A. Chen, and J. F. Worley. 1981. Corn stunt spiroplasma. pp. 40-50. In D. T. Gordon, J. K. Knoke, and G. F. Scott (eds.), Virus and Virus Like Diseases of Maize in the United States. Ohio Agr. Res. & Develop. Ctr.

Diener, T. O. 1981. Viroids. Scien. Amer. 244:58-65.

Diener, T. O. 1981. Viroids as disease agents. Monograph J. Natl. Cancer Inst.

Diener, T. O. 1981. Viroids. Annu. Rev. Plant Physiol. 32:313-325.

Diener, T. O. 1981. In E. Kurstak (ed.), Handbook of Plant Virus Infections, Comparative Diagnosis. Elsevier/North-Holland Biomedical Press, Amsterdam, pp. 913-934.

Diener, T. O. 1981. Are viroids escaped introns. Proc. Natl. Acad. Sci. 78:5014-5015.

Diener, T. O. 1981. Viroids. In: Handbook of Microbiology, second ed. C.R.C. Press, Boca Raton, FL. pp. 917-921.

Farr, D. F., and E. F. Farr. 1981. Proposals to conserve or reject Hypholoma (Fr.) Kumm. against Nematoloma Karst. or Psathyrella (Fr.) Quel. (Agricales). Taxon. 30:329-334.

Farr, M. L., and C. J. Alexopoulos. 1981. Proposal to conserve Stemonitis Roth against Stemonitis Gleditsch and Stemonitis Gleditsch sensu Wiggers (Myxomycetes, Stemonitaceae). Taxon. 30:357-358.

Fletcher, J., G. A. Schultz, R. E. Davis, C. E. Eastman, and R. M. Goodman. 1981. Brittle root of horseradish: Evidence for an etiological role of Spiroplasma citri. Phytopath. 71:1073-1080.

Gillaspie, A. G., Jr., C. A. Thomas, and B. Prescott. 1981. Inhibition of sugarcane mosaic virus symptoms on Sorghum by microbial and plant polysaccharides and their antigenic relationship. Phytopathol. Z. 102:107-113.

Golden, A. M., L. M. Rose, and G. W. Bird. 1981. Description of Meloidogyne nataliei n. sp. (Nematoda: Meloidogynidae) from grape (Vitis labrusca) in Michigan with SEM observations. J. Nematol. 13:393-400.

Habili, N., and J. M. Kaper. 1981. Cucumber mosaic virus-associated RNA 5. VII. Double-stranded form accumulation and disease attenuation in tobacco. Virol. 112:250-261.

Hadidi, A., D. E. Cress, and T. O. Diener. 1981. Nuclear DNA from uninfected or potato spindle tuber viroid-infected tomato plants contains no detectable sequences complementary to closed double-strained viroid cDNA. Proc. Natl. Acad. Sci. 78:6932-6935.

Kaper, J. M., M. E. Tousignant, and S. M. Thompson. 1981. Cucumber mosaic virus-associated RNA 5. VIII. Identification and partial characterization of a CARNA 5 incapable of inducing tomato necrosis. Virol. 114:526-533.

Kaper, J. M., and H. E. Waterworth. 1981. "Cucumoviruses" In E. Kurstak (ed.), Handbook of Plant Virus Infections and Comparative Diagnosis. Elsevier/North Holland, Biomedical Press, Amsterdam, pp. 257-332.

Lewis, S. A., and A. M. Golden. 1981. Description and SEM observations of Dolichodorus marylandicus n. sp. with a key to species of Dolichodorus. J. Nematol. 13:128-135.

Lewis, S. A., and A. M. Golden. 1981. Description of Trilineellus clathrocutis n. gen., n. sp. (Tylenchorhynchinae: Tylenchida Thorne, 1949) with a key to species and observations on Tylenchorhynchus sensu stricto. J. Nematol. 13:135-141.

Lewis, S. A., and A. M. Golden. 1981. Redescription and lectotype designation of Tylenchorhynchus cylindricus Cobb, 1913. J. Nematol. 13:521-528.

Lumsden, R. D. 1981. A nylon fabric for studying the ecology of Pythium aphanidermatum and other fungi in soil. Phytopathol. 71:282-285.

Lumsden, R. D. 1981. Ecology of Mycoparasitism. In D. T. Wicklow and G. C. Carroll (eds.), The Fungal Community, Its Organization and Role in the Ecosystem. Chap. 17. pp. 293-318. Marcel Dekker, Inc., NY.

Nickle, W. R. 1981. Research on pinewood nematode in the United States. Proc. XVII IUFRO World Congress. Kyoto, Japan, pp. 269-271.

Nickle, W. R., A. M. Golden, Y. Mamiya, and W. P. Wergin. 1981. On the taxonomy and morphology of the pinewood nematode, Bursaphelenchus xylophilus (Steiner and Buhrer, 1934) Nickle, 1970. J. Nematol. 13:385-392.

Owens, R. A., and T. O. Diener. 1981. Sensitive and rapid diagnosis of potato spindle tuber viroid disease by nucleic acid hybridization. Sci. 213:670-672.

Papavizas, G. C., and J. H. Bowers. 1981. Comparative fungitoxicity of captafol and metalaxyl to Phytophthora capsici. Phytopathol. 71:123-128.

Papavizas, G. C., and J. A. Lewis. 1981. Introduction and augmentation of microbial antagonists for the control of soilborne plant pathogens. In G. C. Papivizas (ed.), Biological Control in Crop Production. pp. 305-322. Beltsville Symp. Agr. Res. Vol. 5, Allanheld, Osmun Pub.

Sarnanelli, S., L. R. Krusberg, and A. M. Golden. 1981. Corn cyst nematode, Heterodera zeae in the United States. Plant Disease 65:622.

Steere, R. L. 1981. Preparation of freeze-fracture, freeze-etch, freeze-dry, and frozen surface replica specimens for electron microscopy in the denton DFE-2 and DFE-3 freeze-etch units. pp. 131-181. In J. E. Johnson, Jr. (ed.), Current Trends in Morphological Techniques. Vol. II. CRC Press, Boca Raton, FL.

Steere, R. L., and E. F. Erbe. 1981. Hingeless complementary specimen holders for the denton freeze-etch apparatus. pp. 564-565. In 39th Ann. Proc. Electron Microscopy Soc. Amer. San Francisco, CA.

van Vloten-Doting, L., R. I. B. Francki, R. W. Fulton, J. M. Kaper, and L. C. Lane. 1981. Tricornabiridae--a Proposed family of plant viruses with tripartite single-stranded RNA genomes. Intervirol. 15:198-203.

Frederick, Maryland

Bonde, M. R., and G. L. Peterson. 1981. Host range of a Taiwanese isolate of Peronosclerospora sacchari. Plant Dis. 65:739-740.

Damsteegt, V. D. 1981. Exotic virus and viruslike diseases of maize. pp. 110-123 In D. T. Gordon, J. K. Knoke, and G. E. Scott (eds.), Virus and virus-like diseases of maize in the United States. So. Coop. Ser. Bull. 247. Ohio State University, Wooster, OH.

Emge, J. S., J. S. Melching, and C. H. Kingsolver. 1981. Epidemiology of Puccinia chondrillina, a rust pathogen for the biological control of rush skeleton weed in the United States. Phytopathology 71:839-843.

French, R. C., and C. L. Wilson. 1981. The effect of nicotine and related compounds on germination and vacuolation in several species of rust uredospores. Physiol. Plant Path. 19:201-207.

Yeh, C. C., A. T. Tschanz, and J. B. Sinclair. 1981. Induced teliospore formation by Phakospora pachyrhizi on soybeans and other hosts. Phytopathology 71:1111-1112.

St. Paul, Minnesota

Ayers, J. E., J. W. Southern, A. P. Roelfs, and R. D. Wilcoxson. 1981. Inheritance of slow rusting and relationship of Sr genes to slow-rusting of the wheat line FKN. Phytopathology 71:835-838.

Bushnell, W. R. 1981. Incompatibility conditioned by the Mla gene in powdery mildew of barley: The halt in cytoplasmic streaming. Phytopathology 71:1062-1066.

Bushnell, W. R., and J. B. Rowell. 1981. Suppressors of defense reactions: a model for roles in specificity. Phytopathology 71:1012-1014.

Nazareno, N., and A. P. Roelfs. 1981. Adult plant resistance of Thatcher wheat to stem rust. Phytopathology 71:181-185.

Roelfs, A. P., D. H. Casper, and D. L. Long. 1981. Races of Puccinia graminis f. sp. tritici in the United States during 1979. Plant Disease 65:138-140.

Rowell, J. B. 1981. Control of stem rust on spring wheat by triadimefon and fenapanil. Plant Disease 65:235-236.

Rowell, J. B. 1981. Relation of postpenetration events in Idaed 59 wheat seedlings to low receptivity to infection by Puccinia graminis f. sp. tritici. Phytopathology 71:732-736.

Rowell, J. B. 1981. The relationship between slow rusting and a specific resistance gene for wheat stem rust. Phytopathology 71:1184-1186.

Schmidt, J. W., V. A. Johnson, P. J. Mattern, A. F. Dreier, and D. V. McVey. 1981. Registration of Bennett Wheat. Crop Sci. 21:988-989.

Schmidt, J. W., V. A. Johnson, P. J. Mattern, A. F. Dreier, and D. V. McVey. 1981. Registration of Centurk 78 wheat. Crop Sci. 21:989.

Bozeman, Montana

Bockelman, H. E., E. L. Sharp, D. C. Sands, A. L. Scharen, D. E. Mathre, T. W. Carroll, J. Riesselman, and R. F. Eslick. 1981. Field manual of common barley diseases. Montana Ag. Exp. Sta. Bul. No. 734, 54 pp.

Ithaca, New York

Gildow, F. E., and W. F. Rochow. 1981. Selectivity in transmission of plant pathogens by vectors: a luteovirus-aphid model. Chap. 4, p. 61-71. In J. J. McKelvey,, Jr., B. F. Eldridge, and K. Maramorosch (eds.), Vectors of Disease Agents, Interactions With Plants, Animals and Man. Praeger Publishers, NY, 243 pp.

Plaisted, R. L., H. D. Thurston, J. B. Sieczka, B. B. Brodie, E. D. Jones, and R. C. Cetas. 1981. Rosa: a new golden nematode resistant variety for chipping and tablestock. Amer. Potato J. 58:451-455.

Rochow, W. F., and J. E. Duffus. 1981. Luteoviruses and yellows diseases. Chap. 7, pp. 147-170. In E. Kurstak (ed.), Handbook of Plant Virus Infections Comparative Diagnosis. Elsevier/North Holland, Amsterdam. 943 pp.

Corvallis, Oregon

Biermann, B., and R. G. Linderman. 1981. Quantifying vesicular-arbuscular mycorrhizae: a proposed method towards standardization. New Phytol. 87:63-67.

Graham, J. H., and R. G. Linderman. 1981. Effect of ethylene on root growth, ectomycorrhiza formation, and Fusarium infection of Douglas-fir. Can. J. Bot. 59:149-155.

Graham, J. H., and R. G. Linderman. 1981. Inoculation of containerized Douglas-fir with the ectomycorrhizal fungus Cenococcum geophilum. Forest Sci. 27:27-31.

Malajczuk, N., R. G. Linderman, J. Kough, and J. M. Trappe. 1981. Presence of vesicular-arbuscular mycorrhizae in Eucalyptus spp. and Acacia spp., and their absence in Banksia sp. after inoculation with Glomus fasciculatus. New Phytol. 87:567-572.

Charleston, South Carolina

Bhatt, D. P., and G. Fassuliotis. 1981. Plant regeneration from leaf mesophyll protoplasts of eggplant. Z. Pflanzenphysiol. 104:81-89.

Creighton, C. S., and G. Fassuliotis. 1981. Laboratory culture of Filipjevimermis leipsandra Poinar and Welch, a mermithid nematode parasite of chrysomelid larvae. J. Nematol. 13:226-227.

Fassuliotis, G., B. V. Nelson, and D. P. Bhatt. 1981. Organogenesis in tissue culture of Solanum melongena, cv. Florida Market. Plant Sci. Let. 22:119-125.

Jackson, Tennessee

Epps, J. M., L. D. Young, and E. E. Hartwig. 1981. Evaluation of nematicides and resistant cultivar for control of soybean cyst nematode race 4. Plant Dis. 65:665-666.

Lubbock, Texas

Robinson, A. F., C. C. Orr, and C. E. Heintz. 1981. Effects of oxygen and temperature on the activity and survival of Nothanguina phyllobia. J. Nematol. 13:528-535.

Weslaco, Texas

Carter, W. W. 1981. Resistance and resistant reaction of Gossypium arboreum to the reinform nematode, Rotylenchulus reniformis. J. Nematol. 13:368-374.

Carter, W. W. 1981. The effect of Meliodogyne incognita and tissue wounding on severity of seedling disease of cotton caused by Rhizoctonia solani. J. Nematol. 13:374-376.

Logan, Utah

Griffin, G. D. 1981. The relationship of Heterodera schachtii population densities to sugarbeet yields. J. Nematol. 13:180-184.

Griffin, G. D. 1981. The relationship of plant age, soil temperature, and population density of Heterodera schachtii on the growth of sugarbeet. J. Nematol. 13:184-190.

Griffin, G. D. 1981. Pathological differences in Heterodera schachtii populations. J. Nematol. 13:191-195.

Griffin, G. D. 1981. The biology and control of plant-parasitic nematodes on alfalfa. Utah Sci. 42:130-135.

Prosser, Washington

Burke, D. W., D. E. Miller, D. A. Johnson, and G. T. Thompson. 1981. Irrigation and disease management in dry bean production. Washington State Univ. Coop. Exten. EB 0815.

Pullman, Washington

Cook, R. James. 1981. Biological control of plant pathogens: Overview. In G. C. Papavizas (ed.), Biological Control in Crop Production. pp. 23-44, Allanheld, Osmun Publishers, London.

Cook, R. James. 1981. Fusarium diseases in the People's Republic of China. In P. E. Nelson, T. A. Toussoun, and R. J. Cook (eds.), Fusarium Diseases, Biology and Taxonomy. pp. 53-55. The Penn. State Univ. Press, University Park, PA.

Cook, R. James. 1981. Water relations in the biology of Fusarium. In P. E. Nelson, T. A. Toussoun, and R. J. Cook (eds.), Fusarium Diseases, Biology and Taxonomy. pp. 236-244. The Penn. State Univ. Press, University Park, PA.

Cook, R. James, and J. M. Duniway. 1981. Water relations in the life cycles of soilborne plant pathogens. In J. F. Parr (ed.), The Concept of Water Potential Applied to the Study of Soil Microorganisms. Chap. 4. pp. 119-139. Am. Soc. of Agron.

Inglis, D. A., and R. J. Cook. 1981. Calonectria nivalis causes scab in the Pacific Northwest. Plant Disease 65:923-924.

Sitton, J. W., and R. J. Cook. 1981. Comparative morphology and survival of chlamydospores of Fusarium roseum 'Culmorum' and 'Graminearum.' Phytopathology 71:85-90.

Sung, Jae-Mo, and R. J. Cook. 1981. Effect of water potential on reproduction and spore germination by Fusarium roseum 'Graminearum,' 'Culmorum,' and 'Avenaceum'. Phytopathology 71:499-504.

Kearneysville, West Virginia

Slana, L. J., and J. R. Stavely. 1981. Identification of the chromosome carrying the factor for resistance to Meloidogyne incognita in tobacco. J. Nematol. 13:61-66.

Madison, Wisconsin

Conrad, P. L., Janice M. Conrad, and R. D. Durbin. 1981. Effect of tentoxin on cation specificity of solubilized CF_1 from tentoxin sensitive species. In B. R. Selman and S. Selman-Reimer (eds.), Energy Coupling in Photosynthesis. pp. 175-178, Elsevier/North-Holland, NY. 374 pp.

Durbin, R. D. 1981. Chap. 11--Metabolism. pp. 443-448. In R. Durbin (ed.), Toxins in Plant Disease. Academic Press, NY.

Durbin, R. D. 1981. Chap. 14--Applications. pp. 495-505. In R. Durbin (ed.), Toxins in Plant Disease. Academic Press, NY.

Mitchell, R. E., and R. D. Durbin. 1981. Tagetitoxin, a toxin produced by Pseudomonas syringae pv. tagetis: purification and partial characterization. Physiol. Plant Pathol. 18:157-168.

PRINCIPAL CONTACTS - 20270

Berkeley, California -

Dr. R. H. Kurtzman
Plant Protection Phytochemistry Research
USDA/ARS
800 Buchanan Streeet
Berkeley, CA 94710
Tel: 415-486-3408
FTS: 449-3578

Davis, California -

Dr. W. C. Schnathorst
USDA/ARS
Department of Plant Pathology
University of California
Davis, CA 95616
Tel: 916-752-0322
FTS: 453-0322

Salinas, California -

Dr. A. E. Steele
Sugarbeet Production Research
USDA/ARS
P.O. Box 5098
Salinas, CA 93915
Tel: 408-443-2253
FTS: 468-2253

Shafter, California -

Dr. E. Jorgenson
Cotton Research Station
USDA/ARS
17053 Shafter Avenue
Shafter, CA 93263
Tel: 805-754-6391

Miami, Florida -

Dr. D. H. Spalding
Subtropical Horticulture Research Unit
USDA/ARS
13601 Old Cutler Road
Miami, FL 33158
Tel: 305-238-9321
FTS: 350-5820

Orlando, Florida -

Dr. D. T. Kaplan
Entomology-Nematology Research Unit
USDA/ARS
2120 Camden Road
Orlando, FL 32803
Tel: 305-898-6791
FTS: 820-6051

Byron, Georgia -

Dr. T. Gottwald
Southeastern Fruit and Tree Nut Research Laboratory
USDA/ARS
P.O. Box 87
Byron, GA 31008
Tel: 912-956-5656
FTS: 238-0421

Tifton, Georgia

Dr. A. W. Johnson
Nematode and Weeds Research Unit
USDA/ARS
Coastal Plain Experiment Station
Tifton, GA 31793
Tel: 912-386-3372

Urbana, Illinois -

Dr. D. I. Edwards
Soybean Protection Reseach
USDA/ARS
W-Turner Hall
University of Illinois
Urbana, IL 61801
Tel: 217-333-1277
FTS: 957-0996

Baton Rouge, Louisiana -

Dr. W. Birchfield
Nematology Research Laboratory
USDA/ARS
Life Sciences Building
Louisiana State University
Baton Rouge, LA 70803
Tel: 504-388-1464

Beltsville, Maryland -

Dr. A. G. Gillaspie
Applied Plant Pathology Laboratory
USDA/ARS
Room 201, Building 004, BARC-West
Beltsville, MD 20705
Tel: 301-344-3350
FTS: 344-3350

Dr. R. L. Lawson
Florist and Nursery Crops
USDA/ARS
Room 101, Building 004, BARC-West
Beltsville, MD 20705
Tel: 301-344-3244
FTS: 344-3244

Beltsville, Maryland -

Dr. P. L. Lentz
Mycology Labortory
USDA/ARS
Room 316, Building 011A, BARC-West
Beltsville, MD 20705
Tel: 301-344-3365
FTS: 344-3365

Dr. G. C. Papavizas
Soilborne Diseases Laboratory
USDA/ARS
Room 274, Building 011A, BARC-West
Beltsville, MD 20705
Tel: 301-344-3682
FTS: 344-3682

Dr. R. V. Rebois
Nematology Laboratory
USDA/ARS
Room 165A, Building 011A, BARC-West
Beltsville, MD 20705
Tel: 301-344-3660
FTS: 344-3660

Dr. R. L. Steere
Plant Virology Laboratory
USDA/ARS
Room 252, Building 011A, BARC-West
Beltsville, MD 20705
Tel: 301-344-2746
FTS: 344-2746

Dr. J. A. Svoboda
Insect Physiology Laboratory
USDA/ARS
Building 467, BARC-East
Beltsville, MD 20705
Tel: 301-344-2389
FTS: 344-2389

Frederick, Maryland -

Dr. W. M. Dowler
Plant Disease Research Laboratory
USDA/ARS
P.O. Box 1209
Frederick, MD 21701
Tel: 301-663-7344
FTS: 935-7344

St. Paul, Minnesota -

Dr. J. F. Schafer
Cereal Rust Laboratory
USDA/ARS
University of Minnesota
1551 Lindig Avenue
St. Paul, MN 55108
Tel: 612-373-1300
FTS: 725-2069

Bozeman, Montana -

Dr. A. L. Scharen
Cereal Crops Improvement Research
USDA/ARS
Plant Pathology Department
Montana State University
Bozeman, MT 59717
Tel: 406-994-4832
FTS: 585-4411

Ithaca, New York -

Dr. B. B. Brodie
Nematode Research Unit
USDA/ARS
Department of Plant Pathology
Cornell University
Ithaca, NY 14853
Tel: 607-256-3105
FTS: 882-4205

Dr. W. F. Rochow
Luteovirus Research Unit
USDA/ARS
Department of Plant Pathology
Cornell University
Ithaca, NY 14853
Tel: 607-256-3105
FTS: 882-4225

Corvallis, Oregon -

Dr. R. G. Linderman
Ornamental Plants Research Laboratory
USDA/ARS
3420 S.W. Orchard Street
Corvallis, OR 97330
Tel: 503-757-4544
FTS: 420-4544

Charleston, South Carolina -

Dr. G. Fassuliotis
U.S. Vegetable Laboratory
USDA/ARS
2875 Savannah Highway
Charleston, SC 29407
Tel: 803-556-0840
FTS: 677-4396

Brookings, South Dakota -	**Vacancy** Oilseed and Cereals Research USDA/ARS Room 153 Plant Science Building South Dakota State University Brookings, SD 57006 Tel: 605-688-6176
Jackson, Tennessee -	Dr. L. D. Young Nematology Research USDA/ARS 605 Airways Boulevard Jackson, TN 38301 Tel: 901-424-1643 FTS: 222-3756
College Station, Texas -	Dr. J. A. Veech National Cotton Pathology Research Laboratory USDA/ARS F&B Road, P.O. Drawer JF College Station, TX 77841 Tel: 713-846-8821, exts. 232, 233 FTS: 527-1232
Lubbock, Texas -	Dr. C. C. Orr Cotton Production and Engineering Research Unit USDA/ARS Southern Plains Cotton Research Laboratory Route 3 Lubbock, TX 79401 Tel: 806-746-6101 FTS: 738-7413
Weslaco, Texas -	Dr. W. W. Carter Crop Protection and Production Research Unit USDA/ARS P.O. Box 267 Weslaco, TX 78596 Tel: 512-565-2423
Logan, Utah -	Dr. G. D. Griffin Crops Research Laboratory USDA/ARS Utah State University, UMN 63 Logan, UT 84322 Tel: 801-750-3073 FTS: 750-3073

Prosser, Washington -

Dr. D. W. Burke
Vegetable Crops Production Research
USDA/ARS
Irrigated Agriculture Research and
Extension Center
P.O. Box 30
Prosser, WA 99350
Tel: 509-786-3454
FTS: 439-0111

Pullman, Washington -

Dr. R. J. Cook
Wheat Breeding and Production Research
USDA/ARS
209 Johnson Hall
Washington State University
Pullman, WA 99164
Tel: 509-335-3632
FTS: 445-3632

Kearneysville, West Virginia -

Dr. C. L. Wilson
Appalachian Fruit Research Station
USDA/ARS
Route 2, Box 45
Kearneysville, WV 25430
Tel: 304-725-3451
FTS: None

Madison, Wisconsin -

Dr. R. D. Durbin
Plant Disease Resistant Research Unit
USDA/ARS
Department of Plant Pathology
University of Wisconsin-Madison
Madison, WI 53706
Tel: 608-262-1541
FTS: 364-5276

National Research Program 20280

WEED CONTROL TECHNOLOGY FOR PROTECTING CROPS, GRAZING LANDS, AQUATIC SITES, AND NONCROPLAND

This multidisciplinary national research program emphasizes the development of principles of weed science and safe and efficient practices of weed control that can be integrated with other production and protection technology into weed management systems for improving crop and livestock production. This research is essential to the development of high-yielding food, feed, and fiber agroecosystems that will maintain the Nation's food supply and improve the quality of the environment. It supports the missions and goals of ARS,SE and the Department. The intramural research program is organized into 98 projects at 35 domestic locations and is conducted by 73 ARS scientists in cooperation with several Federal agencies, State agricultural experiment stations (SAES), private universities and research institutes, and industrial research organizations. This NRP also supports 39 cooperative extramural research projects by 26 SAES scientists in 25 states and 7 PL480 projects by 10 foreign scientists in four foreign countries. In 1980, progress was reported in more than 135 scientific publications.

NPS Contact: W. C. Shaw

Technological Objective 1: New and improved fundamental knowledge of the biology of weeds for development of safe, new principles and mechanisms of their control by biological, chemical, cultural, ecological, physical, and integrated methods that will avoid or minimize hazards to nontarget organisms and to other components of the environment.

Research Locations:

Tucson, Arizona	Columbia, Missouri
Stuttgart, Arkansas	Ithaca, New York
Albany, California	Raleigh, North Carolina
Tifton, Georgia	Fargo, North Dakota
Urbana, Illinois	College Station, Texas
West Lafayette, Indiana	Temple, Texas
Beltsville, Maryland	Logan, Utah
Frederick, Maryland	Prosser, Washington
St. Paul, Minnesota	Pullman, Washington
Stoneville, Mississippi	Kearneysville, West Virginia

Examples of Recent Progress:

Plant growth regulators used as a way to deplete soil of its reserve of dormant weed seeds - Fargo, North Dakota. The ability of annual weeds such as wild oat to persist in cultivated fields despite heavy herbicide use is due, in part, to the ability of seeds to lie dormant in the soil for many years.

One approach to more effective weed control is the application of chemicals to the soil which break seed dormancy, and cause germination. This would allow for depletion of the soil's weed seed reserve, and therefore, provide greater economical weed control. A new class of plant growth regulators called the phthalimides, evaluated in basic research, show great promise for such use. At low concentrations (10 ppm-100 ppm) the phthalimides were effective in breaking seed dormancy in a variety of weed species including wild oat, field pennycress, wild mustard, and curly dock.

Toxic chemicals in forage cultivars may poison grazing animals - Logan, Utah. Toxic aliphatic nitro compounds that catabolize to 3-nitropropionic acid in the rumen were isolated from 17 species of Lotus. Nitrobearing Lotus pedunculatus, a native of Spain and Portugal, has been released as three cultivars. All cultivars were toxic to 1-week-old chicks and extracts equal to 5 grams of plant were uniformly lethal. These data indicate that all species of Lotus should be screened for nitro compounds before beginning developmental research. The use of Lotus pedunculatus must be restricted for use as forage because of its high nitro content.

Effects of nutrient level on weed and soybean response to CO_2 enrichment - Stoneville, Mississippi. The CO_2 content of the global atmosphere is increasing and may reach 600 to 700 ppm within the next 100 years. In controlled-environment growth chamber studies, we found that, even with severely limited available soil nutrients, the growth of soybean and two leguminous weeds, sicklepod and showy crotalaria, was stimulated by 675 ppm CO_2. Sicklepod, a non-nodulating legume was more limited by low nutrients than was soybean or crotalaria. Differential effects of CO_2 enrichment on important weeds and crops will influence weed/crop interactions in the future.

Further evidence of herbicide effects on enzyme activity of PAL in plants - Stoneville, Mississippi. Phenylalanine ammonia-lyase (PAL) is a key enzyme in phenylpropanoid synthesis. Studies on the effects of various herbicides and other compounds have provided insight into regulatory aspects of PAL activity in plant tissues. In research on the effects of sixteen herbicides from 15 chemical classes on soybean seedlings extractable PAL activity was shown to be positively correlated with the products of phenylpropanoid metabolism, i.e., hydroxyphenolic and anthocyanin levels. No correlation was found between PAL activity levels and the levels of chlorophyll or soluble protein in tissues treated with the herbicides. Another compound, o-benzylhydroxylamine, was found to be a potent in vivo and in vitro PAL inhibitor. These data provide insight into regulator aspects of this important plant enzyme and indicate that extracted PAL activity levels usually reflect relative in vivo activities, and that PAL activity is limiting to phenylpropanoid synthesis in vivo.

New information on physiology of parasitic weeds - Stoneville, Mississippi. A substance Xenognosin, isolated from gum tragacanth, induced haustorial formation of germinated parasitic seed of Agalinis. Previously, host roots were necessary for haustorial formation by the parasite. Thus, this is the first host recognition substance identified for higher plant parasites. Gum tragacanth also contained at least two other substances that induced haustorial formation in Striga seedlings. The germination stimulant, strigol, induced Striga germination but not Striga haustorical formation. This information on recognition of hosts by parasitic plants will make it possible to study

development of obligate parasitic plants in the absence of the host and will enable accumulation of knowledge necessary for development of improved methods for control of the parasitic weed.

New evidence on the mechanism of action of tentoxin, a naturally-occurring herbicide - Stoneville, Mississippi. Tentoxin, a fungal toxin which causes severe chlorosis in many weed species, was previously thought to cause its effects through inhibition of photophosphorylation. Recent work at the SWSL has shown that tentoxin alters chloroplast development through interference with uptake of nuclear-coded proteins by plastids. Several physiological effects of tentoxin in complete darkness have been demonstrated, including: (1) complete inhibition of uptake and activation of polyphenol oxidase; (2) disruption of prothylakoid membranes; and (3) some inhibition of synthesis of protochlorophyll. Plastid envelope ATPase activity is totally eliminated in situ by tentoxin. Effects on greening (lack of cytochrome f oxidation/reduction) are measurable within 20 minutes of exposure to light. These effects indicate that plastid metabolism and function are strongly affected before the time when photophosphorylation would contribute to the greening process. This is the first compound known to specifically prevent uptake of nuclear-coded proteins into the plastid.

Efficacy of starch encapsulated controlled release trifluralin increased - West Lafayette, Indiana. Modification of preparation technology and timing of application of starch encapsulated trifluralin have been shown to be more effective than commercial emulsifiable concentrate. The flexibility of using controlled release formulations of herbicides gives farmers opportunities to spread their work and equipment loads for more efficient farm operation.

Allelochemicals in weeds cause allelopathic activity, affect seed dormancy, repel insect attacks, and cause diseases of livestock - Albany, California. The presence of large quantities of inorganic salts in dormant spikerush seed and esterlides in non-dormant seed may help explain the problem of breaking the dormancy. Two physical barriers, i.e., the inorganic salts, plus little of the esterlide in the dormant seed may contribute to the lack of germination. The presence of blumenol A in leafy spurge may account for the lack of insect activity on leafy spurge since it has been shown that blumenol A affects the growth cycle of grasshoppers. Several cytotoxic sesquiterpene lactones have been isolated from the poisonous plants yellow star thistle and Russian knapweed which cause Equine Nigropallidal Encephalomalacia (ENE) among animals grazing on these weeds. Monitoring the quantities of the specific toxins in the plant throughout the year will provide the rancher valuable informaion as to when to prevent grazing animals from feeding on these plants. The X-ray structural determination of acroptilin, a sesquiterpene lactone, has provided a complete structural assignment which now allows us to assign structural details to all the other sesquiterpene lactones with much greater confidence. Solstialin has shown significant plant growth regulatory activity which possibly accounts for the observed allelopathic activity of yellow star thistle. Identification of the specific agent(s) may help in the control of this invasive weed.

Pathogen for selective weed control discovered - Albany, California. The fungus Dichotomophthora portulacae was isolated from the weed, common purslane (Portulaca oleracea) in California for the first time and proved to be pathogenic. The pathogen might have a significant role in biocontrol of the weed alone or by use in combination with insect predators of the weed, and selective herbicides.

Anesthetics influence weed seed dormancy - Beltsville, Maryland. Several substances which act as anesthetics in animals also markedly affect plant seeds. In particular, they influence the ability of the seeds to remain dormant and force them to germinate when they otherwise would not. The principle may be useful for helping to reduce weed seed populations in soil, thus reducing requirements for other weed control practices.

Adjuvants promote seed germination - Frederick, Maryland. Some surfactants in the oxysorbic or Tween series increased barnyardgrass (Echinochloa crus-galli (L.) Beauv.) germination several fold in laboratory studies. The bioactivity exhibited by these commonly used surfactants may have field utility by reducing the soil reservoir of dormant weed seed.

Weed ovules matured in vitro - Frederick, Maryland. A culture technique has been developed to mature and dehydrate immature velvetleaf (Abutilon theophrasti Medic.) ovules in vitro. This technique permits investigating the influence of the mother plant on ovule development and hormone balance, and possible manipulation of the survival capacity of weed seed.

Technological Objective 2: New and improved weed control technology for use in field crops that will increase efficiency in food, feed, and fiber production, reduce losses in yield and quality, and reduce the cost of control.

Research Locations:

Stuttgart, Arkansas	Stoneville, Mississippi
Shafter, California	Columbia, Missouri
Fort Collins, Colorado	Lincoln, Nebraska
Tifton, Georgia	Fargo, North Dakota
Urbana, Illinois	Corvallis, Oregon
West Lafayette, Indiana	Prosser, Washington
Houma, Louisiana	Pullman, Washington
St. Paul, Minnesota	

Examples of Recent Progress:

Method for propagating field bindweed plants from one progenitor plant - Prosser, Washington. Field bindweed is one of the most serious perennial weed problems in North America. Research on this troublesome species is confounded by the inherent variability encountered in most perennial plants. A vegetative propagation technique has been developed that rapidly generates large numbers of genetically identical bindweed plants. Plants which have developed from root buds of one field-grown plant are transferred to nutrient solution where they in turn produce more plants from buds on their creeping roots. This technique can be repeated indefinitely to produce large numbers of uniform field bindweed plants for research purposes.

Extreme tolerance of seed and emerging seedlings of alfalfa to EPTC allows application of the herbicide directly to seed - Prosser, Washington. In the newly discovered method of controlling weeds selectively in alfalfa, wherein EPTC is applied directly to the alfalfa seed before it is seeded, the alfalfa is exposed to extremely high concentrations of EPTC when first seeded. Alfalfa tolerates this extreme initial exposure because the seeds and emerging seedlings are very tolerant of EPTC. The seedling does not become susceptible to the injury that causes typical EPTC symptoms until it has emerged. By that time, diffusion has reduced the initial high concentration so the seedling is never exposed to an excessive dosage after it becomes susceptible.

Interactions of tillage, fertilizer, and herbicide on wild oat germination, growth, and control - Pullman, Washington. Germination of wild oat seed appears to be influenced to a greater extent by temperature than NO_3 and will germinate at a higher temperature after being stored for a year than when freshly harvested. Wheat responds to soil applications of N, especially NH_4-N, to a greater extent than wild oat. High rates of N reduce the effectiveness of difenzoquat applied for wild oat control which may explain some of the lack of consistency when difenzoquat is used for post-emergence wild oat control.

Jointed goatgrass seedling emergence limited by seed depth - Pullman, Washington. Jointed goatgrass germinates best at 15 or 10 C but is capable of germination at temperatures ranging from 10 to 35 C. Seedlings appear not capable of emerging from greater than 5- to 6-cm depths. This may explain the increase in jointed goatgrass infestations in reduced tillage crop production systems and help identify periods of vulnerability in its life cycle that will improve control technology.

Control of common rye in wheat fields - Pullman, Washington. The damage caused by common rye can be reduced in a wheat crop by applying paraquat or glyphosate through rope wick or roller applicators to control the rye without injury to wheat. Rye seed production and future infestations in wheat can be reduced by using this technique.

New application technology improves chemical weed control and reduces human exposure and environmental risks - Stoneville, Mississippi. The ultimate Stoneville applicator that was developed to make postemergence herbicide applications to weeds growing above the crop became commercially available to producers during 1981. The applicator is operated at field speeds ranging from 3.0 to 4.5 mph and applies a 1 to 6 glyphosate-water solution with a single-direction application. The applicator does not drip or splatter herbicide into the environment, it does not accumulate plant debris or soil particles in the spray solution and the application surface does not dry out in environmental conditions of low humidity, high temperature or brisk wind. This applicator provides the producer with a safe, efficient and economical tool to apply nonselective herbicides to weeds growing above the crop or to plant vegetation where soil contamination must be avoided.

A plant pathogen shows potential as a biological control agent for sicklepod - Stoneville, Mississippi. Alternaria cassiae Jurair and Khan, isolated from diseased sicklepod (Cassia obtusifolia), was pathogenic to sicklepod, coffee senna (Cassia occidentalis), and showy crotalaria (Crotalaria spectabilis). Soybean (Glycine max, peanut (Arachis hypogaea) cotton (Gossypium hirsutum), corn Zea mays), and 26 other crop and weed species in nine families were resistant to the pathogen. Host range and virulence studies indicate this fungus to have potential for use as a biological herbicide for selective control of sicklepod in crops. In irrigated field plots, the pathogen controlled 80% of the weed in 8 days.

Identity of weedy nightshades of the upper midwest clarified - St. Paul, Minnesota. The predominant weedy nightshade of the upper midwestern U.S. has, in the past, been identified as black nightshade (Solanum nigrum). A survey in Minnesota and adjoining states reveals that the predominant weedy nightshade in this area is actually eastern black nightshade (Solanum ptycanthum); a species that can be easily confused with Solanum nigrum. Proper identification of this important weed species is essential to developing control practices and avoiding confusion in the scientific literature. (This survey, based on many samples from a limited geographical area, verifies the broader work of Ogg, et al. 1981. Weed Sci. 29:27-32).

Sugarcane cultivars differ in their tolerance to competition from johnsongrass - Houma, Louisiana. Field research demonstrated that johnsongrass competition with sugarcane can reduce yield of cane/A by an average of 45% during a 3-year crop cycle. The results showed, however, that sugarcane cultivar CP 65-357 can

recover rapidly from the effects of this competition if johnsongrass is removed in early spring. Successful weed management, then, should involve the use of herbicides for early season weed control and the planting of a cultivar like CP 65-357 that can respond rapidly to these control measures.

The volume and quality of water used to apply glyphosate influences its effectiveness of weed control - Urbana, Illinois. Research concerning application of glyphosate has demonstrated that decreasing carrier volume can increase phytotoxicity of glyphosate to annual grass weeds growing in small grain stubble. Further, other research demonstrated that water from various sources resulted in variable control with glyphosate, and where poor water quality resulted in poor control, this could be corrected with certain spray additives. These findings provide ways to improve control with glyphosate, reduce rates of application, and reduce cost of production.

Yields of soybeans and grain sorghum are high in no tillage cropping systems - Watkinsville, Georgia. Through a number of experimental studies and over a three year period the yields of soybean and grain sorghum were as good or better with a no-till type system than with a conventional type tillage system when weeds were controlled by selective herbicides.

Predicting weed losses in sugarbeets - Ft. Collins, Colorado. Reduction in root yield of sugarbeets caused by low densities of common lambsquarters can be predicted. A significant decrease in yields of sugarbeet roots resulted when four to six common lambsquarter plants per 100 feet of row competed with sugarbeets all season. The current trend in sugarbeet production is to thin sugarbeets with electronic machines. Since these machines cannot distinguish between weed and sugarbeet plants, weeds remain in the row after thinning. This means that growers need to know whether it will be economical to remove those weeds that remain. Thus, the predictive equations and the competitive threshold levels of this broadleaf weed will be useful to growers in determining whether they can justify the use of hand labor to remove this broadleaf weed if it remains after thinning.

Herbicide residues do not occur in multiple-crop rotations - Tifton, Georgia. Analysis of soil samples collected on plots that have received multiple or continuous herbicide applications in various cropping sequences over a 5- or 6-year period show that many commonly used herbicides do not present a residue problem. Herbicides such as DCPA, metribuzin, cyanazine, and butylate were not detectable. Sixty days after application, concentrations of trifluralin in the soil averaged 91 ppb; but approximately 120 days after application, the concentrations of trifluralin were 14 ppb. Pendimethalin and ethalfluralin also showed the same response. There has been no evidence of herbicide persistence on succeeding crops grown in rotation.

Seeds of some weeds persist for seven years in Coastal Plain soils - Tifton, Georgia. Texas panicum, Florida beggarweed, sicklepod, morninglories, yellow nutsedge, and cocklebur emerged in areas that had been maintained weed free while growing 21 crops for a 7-year period. The same results had been observed in other studies over a 5-year period involving corn-soybean rotations. These results show that effective weed control programs must be maintained for many years to reduce and maintain low weed infestations.

Some herbicides can be applied postemergence to weeds and soybeans through irrigation systems - Tifton, Georgia. The herbicides acifluorfen, bentazon, sethoxydien, fluazifop-butyl, PPG-844, CGA-82725, and RH-0265 were applied postemergence to soybeans and weeds in a small plot irrigation simulator in irrigation rates of 0.1 or 0.25 inches. All herbicides except bentazon exhibited fair to excellent herbicidal activity. The efficacy was comparable to that observed on other experimental trials where these herbicides were applied by conventional methods. Based on other economic comparisons, applying these herbicides through center pivot irrigation systems can reduce application costs by $2.00/A.

Relatively short nutsedge-free periods in cotton prove helpful in preventing yield losses and buildup of tubers - Shafter, California. A better understanding of the growth habits and competition of yellow nutsedge with cotton was obtained from a 3-year field study. Cotton yields were reduced when nutsedge was not controlled. However, 2 to 6 weeks of hand-weeding gave sufficient control of nutsedge to prevent cotton yield losses. In cotton plots maintained free of nutsedge for 2, 4, 6, 8, and 12 weeks after crop emergence, nutsedge produced only 48, 33, 26, 23, and 13% as many shoots and 28, 18, 10, 14, and 7% as many tubers by harvest as cultivated plots. Furthermore, in 50% of the experiments, the initial number of tubers in the spring was reduced by 50% in the fall by maintaining plots weed-free for only 2 weeks. Knowledge concerning the nature of interaction of weeds and crops can be very helpful in planning effective and economical weed control systems.

Applying glyphosate with selective equipment proves helpful in controlling johnsongrass and improving yields of cotton - Shafter, California. Three applications of glyphosate above the top of cotton by various kinds of wipers provided 70 to 75% control of johnsongrass for 2 to 3 weeks after each application and improved yields of cotton by 30 to 40%. Although applications with one kind of wiper improved yield as much as 50% in 1 of 2 years, which was still 10% less than yields of weed-free plots, treated plots produced on the average 30% less cotton than weed-free plots. Although the temporary control provided by these kinds of treatments is helpful, the presence of the competitive weed before treatment can be made, and the rapid regrowth of johnsongrass following individual treatments, may prevent cotton from yielding normally. Nevertheless, these treatments represent an alternative method for the control of johnsongrass and may still be as effective and economical as other current control methods.

Close-row planting offers promise for increased cotton yields - Shafter, California. Over 3 years, cotton grown on fine sandy loam soil planted in 51-cm rows yielded 15% more than cotton planted in 102-cm rows. The yield advantage for the 51-cm rows was less pronounced on plots that received tillage only for weed control than on plots that received tillage and either trifluralin (0.7 kg/ha) plus prometryn (2 kg/ha) or trifluralin plus fluometuron (1.7 kg/ha) as preplant incorporated treatments before the preplanting irrigation. Herbicide-treated plots had 99% fewer grass weeds and 92% fewer broadleaf weeds than plots that were tilled only. Fluometuron caused some crop injury and plots yielded 7% less than those treated with prometryn with equal weed control.

New herbicide treatments improve weed control in rice - Stuttgart, Arkansas. Problem broadleaf weeds such as hemp sesbania, northern jointvetch, and morningglory are controlled in rice with new herbicide treatments. Hemp sesbania is controlled by midseason applications of acifluorfen alone.

Tank mixtures of acifluorfen with propanil control all three weeds. These new herbicide treatments injure rice less than standard phenoxy herbicides and are safer on nontarget crops. Acifluorfen with and without propanil, used in 1981 on about 50,000 acres, that could not have been treated with phenoxys, increased net profits $10-25/A.

New red rice control programs for soybeans - Stuttgart, Arkansas. New sequential treatments of preplant applications of alachlor or metolachlor followed by postemergence overtop applications of basagran + mefluidide control red rice in rowed and drilled soybeans. Adoption of these techniques will enable farmers to reduce losses from red rice in the rice crop following treated soybeans by an estimated $25 to $50/A on 300,000 acres of rice in the lower Mississippi Valley.

New biological control technique reduces red rice - Stuttgart, Arkansas. Wild ducks feeding during the winter reduces red rice seed in contaminated fields. Rice or soybeans fields, leveed and flooded during the winter, attract waterfowl which eat up to 97% of the red rice seed in the soil. During each of the two winters of 1980-81 and 1981-82 farmers flooded 20-30 thousand acres of red rice-infested land. This practice reduces losses from red rice in the rice crop an estimated $25-$50/A.

Fungi and herbicides control weeds - Stuttgart Arkansas. The weed pathogen, c.g.a., controls northern jointvetch in rice and soybeans. Acifluorfen controls hemp sesbania in both crops. Tank mixtures of the pathogen and the herbicide control both weeds in both crops. The use of this mixture in 1982 should enable farmers to reduce losses incurred by these weeds by an estimated $10-$20/A on 80,000 acres of rice and soybeans.

Technological Objective 3: New and improved weed control technology for use in horticultural crops that will increase production efficiency, reduce losses in yield and quality, and the cost of control.

Research Locations:

Tifton, Georgia	Charleston, South Carolina
Beltsville, Maryland	Weslaco, Texas
Frederick, Maryland	Prosser, Washington
New Brunswick, New Jersey	Kearneysville, West Virginia

Examples of Recent Progress:

Several herbicides control weeds effectively when applied through sprinklers in irrigation water - Prosser, Washington. Bromoxynil, diclofop, and bentazon applied in 0.2 inches (5400 gal/A) of water through a sprinkler irrigation simulator controlled certain emerged annual weeds. These herbicides are actively absorbed through plant foliage and are usually applied in 5 to 40 gallons of water per acre by ground or aerial sprays. This research demonstrated that these herbicides will also control certain weeds when applied through sprinklers in irrigation water. This new technology in weed control reduces costs for fuel, manpower, and equipment.

Herbicides provide full season weed control in blackberries - Beltsville, Maryland. After three years of herbicide evaluations, nine herbicide programs were identified which will be safe to the crop and will provide full season weed control. Blackberries are an increasingly popular pick-your-own crop on small farms in the middle-Atlantic states and require weed-free fields at harvest in order to attract customers.

Chemical composition of tomato plants unaffected by herbicides - Tifton, Georgia. Four cultivars of tomatoes, C-37, 2653, 208F and VF 134, were seeded and treated with 7 herbicides alone or in various combinations. The herbicide treatments had no significant effect on total N, protein N, non-protein N, reducing sugars, non-reducing sugars and total sugars. Significant differences were observed among cultivars, but no interaction with herbicide treatments was determined.

The effectiveness of fungal biocontrol agents for the control of johnsongrass and the interaction of herbicides with these agents - Kearneysville, West Virginia. The pathogenicity of Colletotrichum graminicola and Helminthosporium sp. were established on johnsongrass. Host specificity of strains of C. graminicola were established on corn and johnsongrass. Some environmental parameters for infection were established. Field applications of inoculum of both organisms were effective in reducing johnsongrass growth in the field. Seedlings were killed by both organisms in greenhouse inoculations.

National label registration obtained for use of glyphosate to control weeds - Kearneysville, West Virginia. A National label registration was obtained in the spring of 1981 for the use of glyphosate to control weeds in cranberry plantings. This was the culmination of over five years of research.

Research funds were obtained from IR-4 for this project. Cooperative projects were written and funded with the Universities of Massachusetts, Wisconsin, Washington State, and Rutgers. The research was coordinated to facilitate the obtaining of a National registration of glyphosate for use on cranberries. The use of glyphosate will have a greater impact on the production of cranberries than the combined effect of all the other herbicides previously registered for use on cranberries.

Remote sensing technology aids in detecting weed populations - Weslaco, Texas. Reflectance data from plant canopies generally showed greater weed-crop species differences at 0.85 μ (photographable IR) than 0.55 μ (visible color). These data predicted that color-IR (CIR) photographic film would detect weed populations in several crop species more efficiently than would conventional color (CC) film. Climbing milkweed (Sarcostemma cyanchoides) reflectances at 0.85 μ were greater than those over orange trees; CIR film was superior for serial survey (5,000 ft elevation). Canopy reflectance (0.85 μ over white-flowered ragweed parthenium (Parthenium hysterophorus L.) was greater than over bell pepper and aerial survey was best with CIR film. Reflectance (0.85 μ) was greater with johnsongrass than with maturing grain sorghum and detection at 60,000 ft elevations with CIR film correlated well with ground truth data; 185,000 A were surveyed in each photograph. These data will be subjected to image analyses to compute acreages of weed populations in cultivated crops.

Metribuzin causes yield reduction in susceptible sweet potato lines - Charleston, South Carolina. A field experiment indicated that root yields of sweet potato lines susceptible to metribuzin were reduced by rates that did not affect the yields of tolerant lines. This indicates that herbicide tolerance in sweet potatoes may have an economic impact on growers.

Use of a hand-held wiper for glyphosate application reduces the expense and labor of hand weeding - Charleston, South Carolina. Glyphosate application by a hand-held wiper applicator required approximately half of the man hours that hoeing required for weed control in vegetables. The total expense of weeding was also lower for wiper weeding. Vegetable yields in wiper weeded and hoed plots were not different. These results indicate that significant grower savings and labor reduction may result if hand-held wipers are used instead of hoeing where manual weed control is required.

New tool for controlling weeds in woody nursery stock - Frederick, Maryland. Oxyfluorfen has been registered through IR-4 for use as a herbicide in woody nursery stock. This registration was based on intensive research that proved the efficacy and safety of this selective herbicide for weed control.

Technological Objective 4: New and improved weed control technology for use in forage crops, pastures, rangelands, and turf that will increase efficiency of food and feed production, improve aesthetic values, reduce losses in yield and quality, and reduce the cost of control.

Research Locations:

Flagstaff, Arizona	Reno, Nevada
Tucson, Arizona	Ithaca, New York
Tifton, Georgia	Corvallis, Oregon
Beltsville, Maryland	College Station, Texas
Columbia, Missouri	Temple, Texas
Lincoln, Nebraska	Logan, Utah

Examples of Recent Progress:

The interaction of grass herbicides times nitrogen rate on turf was highly significant - Beltsville, Maryland. Eight years of different fertilizer and herbicide treatments on turf provided noticeably denser turf stands of grass and higher appearance scores when higher nitrogen rates and the more effective herbicides were used. The high nitrogen rate (6 lb/1000 sq ft) and high mowing practice (2.25 inches) provided substantial control of both crabgrass (76%) and dandelions (73%) as compared to the low nitrogen rate (2 lb/1000 sq ft). Benefin, DCPA, and bensulide averaged 97 to 100% control of crabgrass across all treated plots, therefore increasing N rate had no great advantage in crabgrass control with these. However, siduron and DSMA controlled 76 and 69% of the crabgrass, respectively, at the 2 lb N rate but 94 and 93% at the 6 lb N rate.

Metribuzin controls goosegrass in forage bermudagrass - Tifton, Georgia. A postemergence treatment of metribuzin eliminated 95% of the goosegrass, a common, troublesome weed, in a forage bermudagrass planting. This treatment increased bermudagrass coverage by 30% in the first year and can increase bermudagrass hay yields by $120 to $180 during the stand's first two years.

New direct planting methods for establishing legumes in stubbles of silage corn and small grain - Ithaca, New York. USDA scientists at Cornell University have developed methods for planting legumes by direct planting or no-tillage means that result in establishment success and yield equal to or greater than those obtained by conventional tillage. By use of appropriate herbicides and proper time of application after silage, corn, or small grain harvest, or after killing of cover crops, and planting with newly developed drills, success probabilities for establishing legumes exceed 90%. The methods allow planting later into spring and earlier in mid- and late summer. These findings will greatly facilitate conservation of energy on the farm, as well as the soil resource, and at less overall cost to the farmer.

Pastures and run out legume hay fields can be renovated by no-tillage means - Ithaca, New York. USDA researchers have put together a package for site programs involving integrated combinations of herbicides, fertilizers and planting equipment to establish birdsfoot trefoil and clovers in pastures and

sods and have attained very high success probabilities over the last five years. Because of technology developed by federal researchers at Cornell, the percentage of establishment successes in sod have nearly doubled in the last five years. The farmers now have economically feasible options for no-tillage planting of these legumes and will benefit considerably from reduced energy requirements.

Alfalfa can be established in sods after solving the pest problems - Ithaca, New York. Through integrated pest management approaches USDA and Cornell researchers found that alfalfa could be established successfully in sod if the vegetation was controlled by herbicides and if a combination of molluscicide and insecticides were applied at planting. If the combination treatments can be made economically feasible, the incidence of successful no-tillage alfalfa establishments in sod will rise dramatically.

Yellow nutsedge propagation in summer and fall is now better understood - Ithaca, New York. USDA and Cornell researchers developed a scheme for controlling yellow nutsedge in mid-summer-, late summer-, and early fall-planted crops geared to the time of the weed emergence and the subsequent formation of reproductive tubers. Best time for control after emergence shifts with declining day length and soil temperature. Proper timing of herbicide will result in best control of nutsedge and prevention of reproductive tuber formation.

Tebuthiuron detected 78 months after application in northern Arizona - Tucson, Arizona. Soils collected in 1981 at Drake, Arizona, from an area treated with 6 pounds active ingredient of pelleted tebuthiuron in 1975 contained 0.4 pounds active ingredient per acre. The herbicide was mainly in the 6 to 12 inch depth layer of soil. No herbicide was found on areas treated with lower rates. The 6 pounds active ingredient per acre rate is threefold more than recommended. These results indicate why tebuthiuron, a long lived herbicide in the soil, should not be applied at rates higher than recommended. Tebuthiuron applied at the rate of 2 pounds active ingredient per acre was not detected in the soil more than 47 months later in northern Arizona studies.

Tebuthiuron not found below 18 inches in soils in northern Arizona - Tucson, Arizona. Five separate areas in northern Arizona treated with broadcast applications of pelleted tebuthiuron were systematically sampled throughout the soil profile for residues of tebuthiuron. The herbicide was not found deeper than 18 inches at any of the five sites. This indicates that tebuthiuron has limited movement in the soil and should not be expected to contaminate adjacent areas by its movement through the soils.

Noncompetitive cool season growing weeds affect warm season growing perennial forage plant seedlings - Tucson, Arizona. Winter growing annual grasses and forbs grown for two consecutive winters and left as a stubble reduced height and weight of black grama, alkali sacaton, four-wing saltbush, and twinberry planted the following summer. This indicates that even noncompetitive weeds may have to be controlled under certain conditions to establish perennials.

Shallow tillage helps seedling forage plant growth - Tuscon, Arizona. Perennial forage species seedlings grew taller and were generally heavier on areas receiving shallow tillage only 1 inch deep, with or without weed incorporation,

than on untilled plots. This indicates that shallow tillage may be needed to ensure successful establishment of rangeland forage plants. Also, this response supports the hypothesis that soil disturbance by hoofed animals can improve plant growth.

Juniper slash is not harmful to establishing forage stands - Tucson, Arizona. Juniper branches were beneficial when used to mulch range plantings of forage grasses in northern Arizona range revegetation studies. This means that instead of piling and burning juniper slash left over from fuel-wood harvesting or mechanical tree control projects, the slash can be lopped and scattered in the range site to help increase the growth of existing plants and help establish new plants from seeds. This will reduce overall juniper range rehabilitation costs by increasing the chances of successful seeding and forage crop release from tree competition and reduce the disposal cost of piling and burning the excess juniper slash from fuel-wood harvesting or mechanical juniper thinning projects.

Tebuthiuron persists in southern Arizona soils for less than 34 months - Tucson, Arizona. Tebuthiuron, aerially applied at the 20% pelleted formulation in 1977 at the 1 lb a.i./A rate, was not detected in soil 34 months after application. This information is important because it shows that this persistent herbicide will break down in arid, warm soils when applied at rates recommended for the control of rangeland weeds and brush.

Dicamba and 2,4-D aid establishment of forage grass plantings, Tucson-Arizona. Dicamba applied at 0.28 and 0.56 kg a.e./A and 2,4-D applied at 0.56 and 1.12 kg a.e./A gave excellent selective control of broadleaf weeds in sideoats grama plantings when applied at the 1-leaf stage of sideoats grama development. This early selective control resulted in greater stand density and higher forage production 12 months after planting than treatments applied at later stages of development. This information is important because it illustrates the severe competition provided by annual broadleaf weeds to grass seedlings and the importance of removing this competition during the early development of the grass seedling.

Allelopathic substances in tall fescue appear to be organic acids - Columbia, Missouri. Growth inhibiting substances from tall fescue extracts were found in an anion fraction. Substances in the fraction were lactic, succinic, malic, citric, shikimic, glyceric, fumaric, and quinic acids. Further extractions are being made to determine the inhibiting substance present.

Residues of picloram applied with a rope wick applicator diminish after two years - Columbia, Missouri. Picloram was more effective than dicamba, glyphosate, and 2,4-D when used in a rope wick applicator for control of goldenrod and ironweed in pastures. Soil samples bioassayed with soybeans showed that dicamba had disappeared after one year, but picloram had not. However, two years after application, picloram residues no longer were evident on soybeans, thus indicating that forage legumes could be sown into the pasture after two years.

Micro-organisms may have a role in breaking seed dormancy - Columbia, Missouri. Seeds from velvetleaf have an impermeable seed coat that appears to have a role in dormancy. When viewed under the electron microscope, seeds of velvetleaf that had been buried in the soil for 3 years showed that the seed coat had decomposed to expose the palisade layer.

Cost effectiveness of brush and weed control and seeding on big sagebrush rangelands - Reno, Nevada. A large-scale comparison of range improvement practices in a pilot testing research program has provided an opportunity to obtain cost data for use in economic evaluations. Among these comparisons were the longtime standard of using a rangeland plow for control of big sagebrush (Artemisia tridentata Nutt.) versus control with an application of 2 lb/A of a low volatile ester of 2,4-D. The plowing costs $29 per acre for control versus $9 for chemical control. Cost of aerial and ground spraying was essentially the same. Almost 60% of the cost of the spraying was for the 2,4-D. Major costs of plowing were: (1) capital investment (60%), (2) fuel (13%), (3) labor (12%) and (5) repair (16%). Seeding improved forage grasses with rangeland drills averaged $12 per acre. Both of the treatments required additional costs for fencing, water developments, and cultural resource surveys. Potential returns on ranch income evaluated by a linear program model, indicated definite cost effectiveness of range improvement, especially when ample hay for wintering cattle was available and with added flexibility of season of use of crested wheatgrass.

Improving watershed values by brush control and seeding on big sagebrush rangelands. In 1981, 2 years after seeding, all infiltration variables were higher in the brush control improved area than the check, significantly higher statistically in the case of time to ponding and time to runoff. Sediment yield is still slightly higher for the brush control treated area but the difference is not significant. This implies that the plowed and seeded area now has less runoff hazard than an untreated area of the same character, under dry soil conditions. Improvement of watershed characteristics by range improvement probably results from increased vegetation cover, in this case, crested wheatgrass and downy brome.

Chemical weed control assures grass seed production the first year after seeding - Corvallis, Oregon. At present, a year's crop production is lost while establishing tall fescue, orchardgrass, bentgrass, and Kentucky bluegrass for seed production in western Oregon. Research shows that if these grasses are planted in September with irrigation, and weeds are controlled with herbicides, they will yield economic amounts of seed the following summer. Several herbicides show promise for controlling weeds in September plantings so that high-technology would make it possible to establish these grasses without the loss of a year's crop production on about 20,000 acres per year. This technology has the potential to increase farm income from $5 to $10 million per year.

Extension of spray season with 3,6-dichloropicolinic acid - College Station, Texas. Field studies indicated that 3,6-dichloropicolinic acid was not only one of the most effective herbicides for control of honey mesquite but that the season of application may be extended since August and September applications were as effective as May and June treatments. Other foliar-applied herbicides such as 2,4,5-T and picloram are not very effective after June. This would allow application treatment of 3,6-dichloropicolinic acid late in the season when drift to susceptible crops may not be a problem and when weather conditions for spraying may be more favorable.

Absorption and translocation of triclopyr - College Station, Texas. Uptake and transport research with triclopyr were completed in honey mesquite. About equal amounts of the ester and amine were absorbed by leaves and transported to other

plant parts. Transport in phloem to the upper and lower stems was greater early in the season (May) compared to August and September. Triclopyr movement and effectiveness in honey mesquite is similar to 2,4,5-T. Triclopyr is a possible alternative to 2,4,5-T for honey mesquite control. Knowledge of timely application will provide most economical control of honey mesquite with the triclopyr.

Weed control improves kleingrass establishment - College Station, Texas. Field data indicated that kleingrass could be successfully established even under conditions of severe drought during the growing season if annual broadleaf and grassy weeds were controlled.

Combinations of controlled burning and herbicides are effective for management of common goldenweed - Temple, Texas. Common goldenweed is a small shrub which severely reduces forage production on portions of the 20 million acres of rangeland in southern Texas. Earlier research and ranchers' experience have shown that only the most expensive weed control practices provide dependable control of this troublesome species. Controlled burning effectively suppresses infestations of common goldenweed for up to 3 years, however, and the cost of burning is relatively low. Where common goldenweed infestations are too dense to allow sufficient grasses to carry a fire, complete control is consistently obtained with the pelleted herbicides picloram or tebuthiuron. Use of fire in conjunction with pelleted herbicides reduces the required rate of herbicide application by half.

Technological Objective 5: New and improved weed control technology for controlling, managing, or using weed populations to improve water quality, fish and wildlife habitats, and recreational areas in aquatic and noncropland sites.

Research Locations:

Albany, California	Gainesville, Florida
Davis, California	Stoneville, Mississippi
Fort Lauderdale, Florida	Prosser, Washington

Examples of Recent Progress:

Special restrictions for 2,4-D use on irrigation systems unnecessary - Prosser, Washington. The yield and quality of Concord grapes was not affected by three annual applications of irrigation water that contained up to 0.1 ppmw 2,4-D (dimethylamine salt) each. Water containing 2,4-D was applied by sprinklers for 8 hours and totaled 2 inches. Because 0.1 ppmw is the tolerance level for 2,4-D in water used to irrigate most crops and in potable water (World Health Organization tolerance), restrictions on the use of 2,4-D for vegetation management on ditchbanks of canals that deliver water to Concord grape vineyards need not be any more severe than for other uses of water.

Hydrogen peroxide shows potential as an algicide in aquaculture - Stoneville, Mississippi. Hydrogen peroxide has shown potential as an algicide in polyethylene tanks placed in a commercial catfish pond. Harvestable-sized fish and algae-laden pond water were added to the tanks. The peroxide at levels of 5.0 to 7.5 ppm controlled the algae with no fish mortality. This rate could be economical for periodic "pruning" of algal blooms. Irrigation with peroxide in water was not harmful to terrestrial crops and rice in greenhouse studies. An experimental use permit will be applied for and studies are planned to compare the peroxide with currently labeled copper-containing algicides.

Biological control of waterhyacinth reduces costs of control - Ft. Lauderdale, Florida. In cooperation with the U.S. Army Corps of Engineers Aquatic Plant Control Research Program, the weevil species Neochetina eichhorniae and N. bruchi were manually released throughout the Southeast from 1972 through 1977. The moth, Sameodes albiguttalis, was released from 1978 through 1980, and as a result of its natural dispersive ability, became widespread without an operational release program thus reducing implementation costs. Data are now indicating that these biological control agents have had a significant impact by reducing the total waterhyacinth acreage in Louisiana from a pre-1974 average of ca. 1.2 million acres to the present estimate of 350,000 acres. Assuming the same level of control could be achieved in a one-time chemical control effort, the value of this 850,000 acre reduction would be ca. $24 million. Thus, based upon a conservative estimate, the benefit derived from this program exceeds the cost by a ratio of 200:1. Adequate data are not available from other states but studies at specific sites indicate a similar trend is occurring in Florida.

The use of growth retardants for control of aquatic weeds reduces adverse effect of chemical control on biological control agents - Ft. Lauderdale, Florida. Several insect species released for the biological control of waterhyacinth are relatively immobile in one or more stages during their life cycles. As a result, when their host plants are eliminated with herbicides a local extermination of the population of biological control agents results since they are unable to emigrate to other areas. Preliminary studies have shown that plant growth retardants may be useful for slowing the growth of aquatic weeds and thereby reducing their noxious potential while not affecting the biological control agents. This reduced growth also enhances the effect of biological control. This approach may prove to be very important in integrated aquatic plant management strategies.

Chlorsulfuron shows promise for controlling waterhyacinth - Ft. Lauderdale, Florida. Chlorsulfuron provided complete control of waterhyacinth and several other floating and emergent plants at a treatment rate of 20 g/ha after 8 weeks posttreatment. Also, severe growth retardation was observed at treatment rates of 2 to 5 g/ha suggesting its possible use in combination with a biological control agent in an integrated management program for waterhyacinth.

Progress in development of controlled release herbicides for aquatic weed control - Ft. Lauderdale, Florida. In this cooperative program with the Army Corps of Engineers, several controlled release herbicide formulations (CRHF) were evaluated for efficacy to control growth of aquatic weeds. Control of watermilfoil, Myriophyllum spicatum was obtained in flowing-water bioassays with Poly GMA 2,4-D at treatment rates made to maintain constant levels of 0.05 and 0.10 mg/l 2,4-D in the flowing water. Dichlobenilalginate effectively inhibited Hydrilla regrowth from both tubers and rootstock at treatment rates to maintain 0.05 mg/l dichlobenil. Results of evaluations of CRHF are expected to provide the feedback necessary to improve performance of future aquatic herbicide formulations.

Gibberellic acid (GA) enhances phytotoxicity of 2,4-D to waterhyacinth - Ft. Lauderdale, Florida. Combinations of 100 ppmw GA with either 0.5 or 1.0 kg 2,4-D/ha gave satisfactory control of waterhyacinth 8 weeks after treatment. Since 100 ppmw GA alone exhibited no toxicity to hyacinth, the greater phytotoxicity of the mixtures was probably due to the increased toxicity of 2,4-D. The potential is that lower 2,4-D treatment rates may provide comparable hyacinth control through additions of synergists, resulting in reduced control costs and lessened environmental impact from herbicides.

Nematodes discovered attacking aquatic plants - Gainesville, Florida. Aquatic plants were surveyed in north Florida for their natural enemies, especially insects and nematodes. Nematodes were found in the roots of many plants including hydrilla and Eurasian watermilfoil. The species of nematodes and their numbers varied with the locations. This cooperative survey with the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, indicated that nematodes should be considered a possible variable in laboratory studies comparing the effects of different field-collected substrates on aquatic plants. Nematodes might also have potential for controlling aquatic plants.

New compound shows promise for controlling filamentous algae - Davis, California. Greenhouse and field research have demonstrated that PH 4062, an experimental algicide, successfully controls nuisance green algae in ponds. Preliminary studies indicate that phytotoxicity is short-lived which may allow use of this compound in irrigation systems.

Joint federal, state, private hydrilla control research project initiated in Imperial Valley - Davis, California. SEA/ARS, USDI, the State of California and the Imperial Irrigation District have joined forces to develop methods to control the noxious weed hydrilla. The project Lead Scientist has assembled a team that will investigate new integrated weed control methods to reduce the economic impact of this weed that has already required California and federal agencies to expend over 3 million dollars.

PUBLICATIONS

Tucson, Arizona

Johnsen, T. N., Jr. and F. B. Gomm. 1981. Forage plantings on six Arizona pinyon-juniper subtypes. J. Range Management 34(2):131-136.

Lavin, F., T. N. Johnsen, Jr., and F. B. Gomm. 1981. Mulching, furrowing, and fallowing of forage plantings on Arizona pinyon-juniper ranges. J. Range Management 34(3):171-177.

Morton, H. L., et al. 1981. The biologic and economic assessment of silvex. USDA-States-EPA-Silvex RPAR Assessment Team, Final Draft Report, 221p.

Stuttgart, Arkansas

Barrett, M. R., T. L. Lavy, D. W. Hoffman, and R. J. Smith, Jr. 1981. Pendimethalin (Prowl) dissipation in flooded and non-flooded soil. Proc. So. Weed Sci. Soc. 34:247-248.

Smith, R. J., Jr. 1981. Herbicide programs for weed control in rice. USDA-ARS Agricultural Research Results (A 106:13:S-8) 52 pp.

Smith, R. J., Jr. 1981. Control of red rice (Oryza sativa) in water-seeded rice (O. sativa). Weed Sci. 29:663-666.

Templeton, G. E., R. J. Smith, Jr., D. O. TeBeest, J. N. Beasley and R. A. Klerk. 1981. Field evaluation of dried fungus spores for biocontrol of curly indigo in rice and soybeans. Arkansas Farm Research 30(6):8.

Albany, California

Maddox, D. M. 1981. Introduction, phenology, and density of yellow starthistle in coastal, intercoastal, and central valley situations in California. U. S. Dept. of Agric., ARS, Agricultural Research Results, ARR-W-20/July 1981, 33pp.

Davis, California

Anderson, L. W. J. 1981. Effect of light on the phytotoxicity of fluridone in American pondweed (Potamogeton nodosus) and Sago pondweed (P. pectinatus). Weed Sci. 29:723-728.

Anderson, L. W. J. 1981. Hydrilla - a costly and destructive weed. Agricult. Res. 29(7-81):4-7.

Anderson, L. W. J. 1981. Control of aquatic weeds with Hexazinone. J. Aquat. Plant Manage. 19:9-14.

Holm, L. and R. R. Yeo. 1981. The biology, control and utilization of aquatic weeds, Part IV. Weeds Today. 12:3-4.

Shafter, California

Keeley, P. E., and R. J. Thullen. 1981. Control and competitiveness of johnsongrass (Sorghum halepense) in cotton (Gossypium hirsutum). Weed Science 29: 356:359.

Miller, J. H., C. H. Carter, R. H. Garber and H. B. Cooper. 1981. Response of acala cotton varieties to preplant trifluralin or layby diuron. Proc. Western Society of Weed Science. 34:101-108.

Miller, J. H., H. M. Kempen, D. W. Cudney, B. B. Fischer, and P. E. Keeley. 1981. Weed control in cotton. University of California leaflet 2991, 19 pages.

Thullen, R. J., and P. E. Keeley. 1981. Longevity of buried yellow nutsedge tubers. Proc. Western Socity of Weed Science. 34:81-86.

Fort Collins, Colorado

Schweizer, E. E. 1981. Broadleaf weed interference in sugarbeets (Beta vulgaris). Weed Sci. 29:128-133.

Fort Lauderdale, Florida

Balciunas, J. K. and T. D. Center. 1981. Preliminary host specificity tests of a Panamanian Parapoynx as a potential biological control agent for hydrilla. Environ. Entomol. 10 (4): 462-467.

Balciunas, J. K. and D. H. Habeck. 1981. Recent range extension of a hydrilla-damaging moth, Parapoynx diminutalis (Lepidoptera:Pyralidae). Fla. Ent., 64 (1): 185-186.

Center, T. D. 1981. Sameodes albiguttalis, a new biocontrol agent for waterhyacinth. Aquatics 3 (4): 8-12.

Center, T. D. 1981. Biological control and its effect on production and survival of waterhyacinth leaves. Proc. 5th. Int. Symp. Biol. Contr. Weeds, Brisbane, Austral., 1980, 393-410.

Center, T. D. and W. C. Durden. 1981. Release and establishment of Sameodes albiguttalis for the biological control of waterhyacinth. Environ. Entomol. 10 (4): 75-80.

Center, T. D. and N. R. Spencer. 1981. The phenology and growth of waterhyacinth (Eichhornia crassipes (Mart.)Solms) in a eutrophic north-central Florida lake. Aquat. Bot. 10 (1):1-32.

Garrard, L. A. and T. K. Van. 1981. Freshwater vascular plants. in: Handbook of Biosolar Resources. Vol. 1, Basic Principles. C. C. Black and A. Mitsui, eds., CRC Press, Florida, 704 pp.

Gainesville, Florida

Buckingham, G. R. 1981. Evaluation of insect species for biocontrol of aquatic plants. Pages 157-161 In Proceedings 15th Annual Meetings, Aquatic Plant Control Research Planning and Operations Review, Misc. Paper A-81-3. U.S. Army Engineer Waterways Experiment Station, U.S. Crops of Engineers, Vicksburg, MS.

Buckingham, G. R., C. A. Bennett, and B. M. Ross. 1981. Investigation of two insect species for control of Eurasian watermilfoil. Final Report to the Waterways Experiment Station, U.S. Corps of Engineers. Technical Report A-81-4, 53 pages.

Buckingham, G. R. and M. Buckingham. 1981. A laboratory biology of Pseudolampsis guttata (LeConte) (Coleoptera:Chrysomelidae) on waterfern, Azolla caroliniana Willd. (Pteridophyta:Azollaceae). Coleopterists Bull. 35(2): 181-188.

Tifton, Georgia

Buchanan, G. A., E. W. Hauser, and R. M. Patterson. 1981. Control of bur gherkins (Cucumis anguria) in peanuts (Arachis hypogaea) with herbicides. Peanut Sci. 8:66-73.

Glaze, N. C., S. A. Harmon, and S. C. Phatak. 1981. Enhancement of herbicidal weed control in sweet potatoes (Ipomea batatas) with cultivation. Weed Science 29:275-281.

Glaze, N. C. 1981. Weeds versus sweet potatoes. Which herbicides give you the fewest weeds, the most potatoes? Ga. Ag. Res. 22(3):14-15.

Hauser, E. W. and G. A. Buchanan. 1981. Influence of row spacing, seeding rates, and herbicide systems on the competitiveness and yield of peanuts. Peanut Sci. 8:74-81.

Hauser, E. W. and G. A. Buchanan. 1981. Are close-rows profitable? Southeast Peanut Farmer 19:10. January.

Hauser, E. W., G. A. Buchanan, J. E. Harvey, W. L. Currey, D. W. Gorbet, and N. A. Minton. 1981. Pesticide interactions with peanut cultivars. Peanut Science 8(2):142-144.

Johnson, A. W., C. A. Jaworski, N. C. Glaze, D. R. Sumner, R. B. Chalfant. 1981. Effects of film mulch and soil pesticides on nematodes, weeds and yields of vegetable crops. J. Nematol. 13:141-148.

Johnson, A. W., W. A. Rohde, C. C. Dowler, N. C. Glaze, and W. C. Wright. 1981. Influence of water and soil temperature on the concentration and efficacy of phenamiphos for control of root-knot nematodes. J. Nematol. 13:148-153.

Phatak, S. C., E. D. Threadgill, N. C. Glaze, and C. C. Dowler. 1981. Preplant tillage, soil strength, and root growth of turnip greens. J. Amer. Soc. Hort. Sci. 106:137-140.

Rohde, W. A., L. E. Asmussen, E. W. Hauser, M. L. Hester, and H. D. Allison. 1981. Atrazine persistence in soil and transport in surface and subsurface runoff from plots in the Coastal Plain of the southern U.S. Agro-Ecosystems 7:225-228.

Sumner, D. R., S. C. Phatak, D. A. Smittle, A. W. Johnson, and N. C. Glaze. 1981. Control of cucumber foliar disease, fruit rot, and nematodes by chemicals applied through overhead sprinkler irrigation. Plant Disease 65:401-404.

Urbana, Illinois

Ahrens, W. H., C. J. Arntzen, and E. W. Stoller. 1981. Chlorophyll fluorescence assay for the determination of triazine resistance. Weed Science 29:316-322.

Ahrens, W. H., L. M. Wax, and E. W. Stoller. 1981. Identification of triazine-resistant Amaranthus spp. Weed Science 29:345-348.

Ghadiri, H., G. A. Wicks, C. R. Fenster, and O. C. Burnside. 1981. Control of weeds in winter wheat (Triticum aestivum) and untilled stubble with herbicides. Weed Science 29:65-70.

Johnson, R. R., and L. M. Wax. 1981. Stand establishment and yield of corn as affected by herbicides and seed vigor. Agronomy Journal 73:859-863.

Wax, L. M. 1981. Weed control for soybeans in 1981. Weeds Today/Early Spring, p.4-5.

West Layafette, Indiana

Hagwood, E. S., Jr., T. T. Bauman, J. J. Williams, Jr. and M. M. Schreiber. 1981. Growth analysis of soybean (Glycine max) in competition with jimsonweed (Datura stromonium). Weed Sci. 29:500-504.

Kriz, Camille C. 1981. The effect of intraspecific and interspecific interference on the growth of robust purple foxtail and redroot pigweed within soybeans. Master of Science Thesis, August 1981. 514 pp. Purdue Univ.

Beltsville, Maryland

Suzuki, S. and R. B. Taylorson. 1981 Ethylene inhibition of phytochrome-induced germination in Potentilla norvegica L. seeds. Plant Physiol. 68:1385-1388.

Taylorson, R. B. and S. B. Hendricks. 1981. Anesthetic release of seed dormancy - an overview. Isr. J. Bot. 29:273-280.

Woodstock, L. W. and R. B. Taylorson. 1981. Ethanol and acetaldehyde in imbibing soybean seeds in relation to deterioration. Plant Physiol. 67:424-428.

Frederick, Maryland

Creager, R. A. 1981. A comparison of oxadiazon and oryzalin in container-grown nursery stock. SNA Res. J. 7(2):15-28.

Frank, J. R. 1981. Introduction to the Symposium Integrated Pest Management - Present and Future. HortScience 16(4):500.

Frank, J. R., and J. A. Simon. Glyphosate and paraquat effectiveness in woody nursery stock. Weed Sci. 29(4):455-461.

St. Paul, Minnesota

Anderson, R. N. 1981. Increasing herbicide tolerance of soybeans (Glycine max) by increasing seeding rates. Weed Sci. 29:336-338.

Anderson, R. N. and Koukkari, W. L. 1981. Time-of-day effects in herbicide application. Proc. 8th Conf. Asian-Pacific Weed Sci. Soc. pp. 301-306.

Stoneville, Mississippi

Azlin, W. R., and C. G. McWhorter. 1981. Preharvest effects of applying glyphosate to soybeans (Glycine max). Weed Sci. 29:123-127.

Azlin, W. R., and C. G. McWhorter. 1981. Johnsongrass (Sorghum halepense) control in soybean (Glycine max) with metriflufen applied postemergence. Weed Sci. 29:139-143.

Baer, R. G., and P. C. Quimby, Jr. 1981. Development of technology for the mass-rearing of Arzama densa. Proc. 15th Annual Meeting, Aquatic Plant Control Research Planning and Operations Review, Nov. 1980, Savannah, GA, U.S. Army Engineer Waterways Experiment Station, Misc. Paper A-81-3, pp. 162-164.

Baer, R. G., and P. C. Quimby, Jr. 1981. Laboratory rearing and life history of Arzama densa, a potential native biological control agent against waterhyacinth. J. Aquat. Plant Manage. 19:22-26.

Cathey, G. W., C. D. Elmore, and B. L. McMichael. 1981. Some physiological responses of cotton leaves to foliar applications of potassium 3,4-dichloro-isothiazole-5-carboxylate and S,S,S-tributyl phosphorotrithioate. Physiol. Plant. 51:140-144.

Chandler, J. M. 1981. Estimated losses of crops to weeds. Pages 95-109 in: D. Pimental ed, Handbook of Pest Management in Agriculture, Volume I, Boca Raton, FL, 597 pp.

Chandler, J. M. 1981. Recent innovative developments in equipment for ground application of herbicides. Florida Conference on Pesticide Application Technology, University of Florida, Gainesville, FL, p. 149-158.

Chandler, J. M. Recirculating Wiper for Agricultural Chemicals. U.S. Patent Case Number PC-6839.

Dale, J. E. 1981. Wick-applied glyphosate reduces johnsongrass population. Proc. South. Weed Sci. Soc. 34:297-299.

Dale, J. E. 1981. Apparatus for continuous injection of chemically-impregnated filament. Patent Pending, P.C. 6832. U.S. Patent Office.

Dale, J. E. 1981. Difenopenten-ethyl for grass weed control in ornamental cacti. J. Hortic. Sci. 56(3):189-191.

Duke, S. O., and R. E. Hoagland. 1981. Effects of glyphosate on the metabolism of phenolic compounds VII. Root-fed amino acids and glyphosate toxicity in soybean (Glycine max) seedlings. Weed Sci. 29:297-302.

Duke, S. O., D. H. Netzley, and J. W. McClure. 1981. Tissue localization of phytochrome in dark-grown barley seedlings. Phytochem. 20:2327-2328.

Egley, G. H., and R. N. Paul, Jr. 1981. Morphological observations on the early imbibition of water by Sida spinosa (Malvaceae) seed. Amer. J. Bot. 68:1056-1065.

Elmore, C. D., and B. L. McMichael. 1981. Proline accumulation by water and nitrogen stressed cotton. Crop Sci. 21:244-248.

Frick, K. E., and R. F. Wilson. 1981. Head capsule measurements of Bactra verutana larvae reared on an artificial diet. Environ. Entomol. 10:237-239.

Hoagland, R. E., and S. O. Duke. 1981. Glyphosate: a unique herbicide. Weeds Today 12:21-23.

Hoagland, R. E., and S. O. Duke. 1981. Effects of herbicides on growth and extractable phenylalanine ammonia-lyase activity in light and dark-grown soybean (Glycine max) seedlings. Weed Sci. 29:433-439.

McWhorter, C. G. 1981. Overview of weed control in soybeans. Pages in 67-67 in Innovations 80's, Conf. Proc. of the American Soybean Assoc. 75pp.

McWhorter, C. G. 1981. Effect of temperature and relative humidity on the translocation of ^{14}C-metriflufen in johnsongrass (Sorghum halepense) and soybeans (Glycine max). Weed Sci. 29:87-93.

McWhorter, C. G., and J. M. Anderson. 1981. The technical and economic effects of johnsongrass (Sorghum halepense) control in soybeans (Glycine max). Weed Sci. 29:245-253.

McWhorter, C. G., and F. L. Baldwin. 1981. Advances in johnsongrass control. Weeds Today 12:12-15.

Ouzts, J. D., S. H. Kay, and P. C. Quimby, Jr. 1981. Susceptibility of Aedes aegypti to various levels of hydrogen peroxide. Mosquito News 41:375-376.

Patterson, D. T. 1981. Effects of allelopathic chemicals on growth and physiological responses of soybean (Glycine max). Weed Sci. 29:53-59.

Quimby, P. C., Jr. 1981. Preliminary evaluation of hydrogen peroxide as a potential herbicide for aquatic weeds. J. Aquat. Plant Manage. 19:53-55.

Riopel, J. L., and L. J. Musselman. 1979. Experimental initiation of haustoria in Agalinis purpurea (Scrophulariaceae). Am. J. Botany 66:570-575.

Schonbeck, M. W., and G. H. Egley. 1981. Changes in sensitivity of Amaranthus retroflexus L. seeds to ethylene during preincubation. I. Constant temperatures. Plant, Cell and Environ. 4:229-235.

Schnonbeck, M. W., and G. H. Egley. 1981. Changes in sensitivity of Amaranthus retroflexus L. seeds to ethylene during preincubation. II. Effects of alternating temperature and burial in soil. Plant, Cell and Environ. 4:237-242.

Schonbeck, M. W., and G. H. Egley. 1981. Phase-sequence of redroot pigweed seed germination responses to ethylene and other stimuli. Plant Physiol. 68:175-179.

Vaughn, K. C. 1981. Plastid fusion as an agent to arrest sorting out. Curr. Genet. 3:243-245.

Vaughn, K. C. 1981. Organelle transmission in higher plants: organelle alteration vs. physical exclusion. J. Hered. 72:335-337.

Vaughn, K. C., and S. O. Duke. 1981. Histochemical localization of nitrate reductase. Histochem. 72:191-198.

Vaughn, K. C., and S. O. Duke. 1981. Tissue localization of polyphenol oxidase in Sorghum. Protoplasma 108:319-327.

Vaughn, K. C., and S. O. Duke. 1981. Tentoxin-induced loss of plastidic polyphenyl oxidase. Physiol. Plant. 53:421-428.

Vaughn, K. C., and S. O. Duke. 1981. Cytochemical localization of photosystem II donor sites. Histochem. 73:363-369.

Walker, H. L. 1981. Granular formulation of Alternaria macrospora for control of spurred anoda (Anoda cristata). Weed Sci. 29:342-345.

Walker, H. L. 1981. Factors affecting biological control of spurred anoda (Anoda cristata) with Alternaria macrospora. Weed sci. 29:505-507.

Walker, H. L. 1981. Fusarium lateritium: A pathogen of spurred anoda (Anoda cristata), velvetleaf (Abutilon theophrasti), and prickly sida (Sida spinosa). Weed Sci. 29:629-631.

Wills, G. D., and C. G. McWhorter. 1981. Effect of environment on the translocation and toxicity of acifluorfen to Crotalaria (Crotalaria spectabilis). Weed Sci. 29:397-401.

Columbia, Missouri

Peters, E. J., and S. A. Lowance. Effects of date and depth of burial on wild garlic. Weed Sci. 29:110-113.

Peters, E. J., and A. H. B. Mohammed Zam. Allelopathic effects of tall fescue genotypes. Agron. J. 73:56-58.

Lincoln, Nebraska

Lamp, W. O., and M. K. McCarty. 1981. Biology and ecology of the Platte thistle (Cirsium canescens). Weed Science 29:686-692.

Reno, Nevada

Roundy, B. A., J. A. Young and R. A. Evans. 1981. Phenology of salt rabbitbrush (Chrysothamnus nauseosus ssp. consimilis) and greasewood (Sarcobatus vermiculatus). Weed Sci. 29:448-454.

Young, J. A. and R. A. Evans. 1981. Demography and fire history of a western juniper stand. J. Range Manage. 34:501-506.

Young, J. A. and R. A. Evans. 1981. Something of value - Energy from wood on rangelands. Rangelands 3:10-12.

Ithaca, New York

Dowling, P. M. and D. L. Linscott. 1981. Effect of chemicals on establishment of direct-planted alfalfa. Proc. NE Weed Sci. Society. 35:42-43.

Linscott, D. L., E. B. Rayburn, and J. F. Hunt. 1981. Herbicide and tillage effects on legume establishment in brome grass sod. Proc. NE. Weed Sci. Soc. 35:67-68.

Rayburn, E. B., J. F. Hunt and D. L. Linscott. 1981. Three year summary of no-till establishment research plots in New York. NE Weed Sci. Soc. 35:65-66.

Fargo, North Dakota

Miller, S. D., J. D. Nalewaja and E. Pacholak. 1981. MSMA for weed control in wheat (Triticum aestivum). Weed Science 29:33-37.

Olson, W. A. and J. D. Nalewaja. 1981. Antagonistic effects of MCPA on wild oat (Avena fatua) control with diclofop. Weed Science 29:566-571.

Olson, W., J. D. Nalewaja, G. L. Schroeder and M. E. Duysen. 1981. Diclofop and MCPA influence on coleoptile growth. Weed Science 29:566-571.

Rathmann, D. P. and S. D. Miller. 1981. Wild oat (Avena fatua) competition in soybean (Glycine max). Weed Science 29:410-414.

Corvallis, Oregon

Lee, W. O. 1981. Control of annual bluegrass (Poa annua) in perennial ryegrass (Lolium perenne) seed fields. Weed Science 29:444-447.

College Station, Texas

Bovey, R. W. and R. E. Meyer. 1981. Effects of 2,4,5-T, triclopyr, and 3,6-dichloropicolinic acid on crop seedlings. Weed Sci. 29:256-261.

Bovey, R. W., and R. E. Meyer. 1981. The response of honey mesquite to herbicides. The Tex. Agric. Expt. Sta. B-1363, 12 p.

Bovey, R. W., R. E. Meyer and J. R. Baur. Potential herbicides for brush control. J. Range Manage. 34:144-148.

Mayeux, H. S., Jr., W. R. Jordan, R. E. Meyer and S. M. Meola. 1981. Epicuticular wax deposits on goldenweed (Isocoma) leaves. Weed Sci. 29:389-393.

Scifres, C. J., J. W. Stuth and R. W. Bovey. 1981. Control of oaks (Quercus spp.) and associated woody species on rangeland with tebuthiuron. Weed Sci. 29:270-275.

Temple, Texas

Adams, J. A., A. S. Endo, H. B. Johnson, J. A. Hall, and P. G. Rowlands. 1981. Effects of disturbance on desert soils, vegetation, and community processes with emphasis on off-road vehicles. A Critical Review. USDI/Bureau of Land Management Desert Plan Staff Special Publication. pp. 191.

Mayeux, H. S., Jr. and L. Leotta. 1981. Germination of broom snakeweed (Gutierrezia sarothrae) and threadleaf snakeweed (G. microcephalum) seed. Weed Sci. 29(5):530-534.

Mayeux, H. S., Jr. and C. J. Scifres. 1981. Drummond's goldenweed and its control with herbicides. J. Range Manage. 34(2):98-101.

McLeod, R. G., and H. B. Johnson. 1981. Resource inventory techniques used in the California Desert. pp. 260-272 In N. G. Lund, M. C. Deloya, LR. Briscoll, W. Bonner, and R. Hamre (eds.) Arid Land Resource Inventories: Developing Cost Efficient Methods. USDA Forest Service General Technical Report WO-28, pp. 620.

Rowlands, P. G., H. B. Johnson, E. Ritter, and A. Endo. 1981. Mojave Desert. Chap. 4, pp 103-162 In Gordon L. Bender (ed.) Handbook of North American Deserts. Greenwood Publishing Co., Westport, Connecticut, pp 600.

Weslaco, Texas

Gausman, H. W., R. M. Menges, A. J. Richardson, H. Walter, R. R. Rodriguez, and S. Tamez. 1981. Optical parameters of leaves of seven weed species. Weed Sci. 29:24-26.

Menges, R. M. and S. Tamez. 1981. Response of onion (Allium cepa) to annual weeds and postemergence herbicides. Weed Sci. 29:74-79.

Menges, R. M. and S. Tamez. 1981. Response of cucumber (Cucumis sativus) to annual weeds and herbicides. Weed Sci. 29:(2)pp 200-208.

Menges, R. M. and S. Tamez. 1981. Interference of common sunflower (Helianthus annuus) in onions (Allium cepa). Weed Sci. 29:641-647.

Logan, Utah

Cronin, E. H. and D. B. Nielsen. 1981. Larkspurs and livestock on rangelands of western North America. Down to Earth. 37(3):11-16.

Cronin, E. H., M. C. Williams, and J. D. Olsen. 1981. Toxicity and control of kelsey milkvetch. J. Range Manage. 34(3):181-183.

Williams, M. C. 1981. Nitro compounds in Indigofera species. Agronomy J. 73:434-436.

Williams, M. C. 1981. Nitro compounds in foreign species of Astragalus. Weed Sci. 29:261-269.

Williams, M. C. and E. H. Cronin. 1981. Ten-year control of western false hellebore (Veratrum californicum). Weed Sci. 29:22-23.

Ziemkiewicz, P. F. and E. H. Cronin. 1981. Germination of seed of three varieties of spotted locoweed. J. Range Manage. 34(2):94-97.

Prosser, Washington

Comes, R. D., L. Y. Marquis, and A. K. Kelley. 1981. Response of seedlings of three perennial grasses to dalapon, amitrole and glyphosate. Weed Sci. 19:619-621.

Dawson, J. H. 1981. Selective weed control with EPTC-treated seed of alfalfa (Medicago sativa). Weed Sci. 19:105-110.

Folwell, R. J., D. L. Fagerlie, G. Tomaki, A. G. Ogg, R. D. Comes, and J. L. Baritelle. 1981. Economic evaluation of selected cultural methods for suppressing the green peach aphid as a vector of virus diseases of potatoes and sugarbeets. Wash. State Univ. Coll. of Agric. Res. Cntr. Bull. 0900.

Marquis, L. Y., R. D. Comes, and C. P. Yang. 1981. Absorption and translocation of fluridone and glyphosate in submersed vascular plants. Weed Sci. 29:229-236.

Ogg, A. G., Jr., B. S. Rogers, and E. E. Schilling. 1981. Characterization of black nightshade (Solanum nigrum) and related species in the United States. Weed Sci. 29:27-32.

Ogg, A. G., Jr. 1981. Weed control in asparagus. Ag Marketer Magazine 7:22-27.

Rogers, B. S. and A. G. Ogg, Jr. 1981. Biology of weeds in the Solanum nigrum complex (Solanum section Solanum) in North America. SEA-USDA, ARM-W-23. 30 pp.

Kearneysville, West Virginia

Welker, W. V., Jr. 1981. A self-feeding, hand-held herbicide wiper. Proc. NE Weed Science Society 35:345-346.

Young, R. S., and W. V. Welker, Jr. 1981. Oryzalin alone and in combination for culture of fruit trees. Proc. NE Weed Science Society 35:138-142.

PRINCIPAL CONTACTS - NRP 20280

Fairbanks, Alaska	Dr. Jeffery S. Conn Agricultural Experiment Station USDA, ARS, WR University of Alaska Fairbanks, AK 99701 Tel: 907-479-7614
Tucson, Arizona	Dr. Howard L. Morton Rangeland Weed & Brush Control Research USDA, ARS, WR 2000 East Allen Road Tucson, AZ 85719 Tel: 602-792-6881 FTS: 762-6881
Stuttgart, Arkansas	Dr. Roy J. Smith, Jr. USDA, ARS, SR P. O. Box 287 Stuttgart, AR 72160 Tel: 501-673-2661
Albany, California	Dr. Lloyd A. Andres Biological Control of Weeds Laboratory USDA, ARS, WR 1050 San Pablo Avenue Albany, CA 94706 Tel: 415-486-3798 FTS: 449-3998
Berkeley, California	Dr. L. Jurd Natural Products Chemistry Western Regional Research Center USDA, ARS, WR 800 Buchanan Street Berkeley, CA 94706 Tel: 415 486-3695 FTS: 449-3695
Davis, California	Dr. Lars W. J. Anderson USDA, ARS, WR Botany Department University of California Davis, CA 95616 Tel: 916-752-6260 FTS: 453-6260
Shafter, California	Dr. Paul E. Keeley U.S. Cotton Research Station USDA, ARS, WR 17053 N. Shafter Avenue Shafter, CA 93263 Tel: 805 323-6153

Fort Collins, Colorado	Dr. Edward E. Schweizer USDA, ARS, WR Crops Research Laboratory Colorado State University Ft. Collins, CO 80523 Tel: 303-482-7717 FTS: 323-5206
Fort Lauderdale, Florida	Dr. Kerry K. Steward Aquatic Plant Management Laboratory USDA, ARS, SR 3205 SW 70th Avenue Fort Lauderdale, FL 33314 Tel: 305-583-5541 FTS: 820-7982
Gainesville, Florida	Dr. Gary R. Buckingham Biological Pest Control Research Unit USDA, ARS, SR P. O. Box 1269 Gainesville, FL 32605 Tel: 904-372-3505, Ext. 302 FTS: 946-7271
Tifton, Georgia	Dr. Clyde C. Dowler Nematode & Weeds Research Unit USDA, ARS, SR Ga. Coastal Plains Experiment Station Tifton, GA 31794 Tel: 912-386-3353
	Dr. A. W. Johnson, RL Nematode & Weeds Research Unit USDA, ARS, SR Ga. Coastal Plains Experiment Station Tifton, GA 31794 Tel: 912-386-3370-2
Watkinsville, Georgia	Dr. E. L. Robinson So. Piedmont Conservation Research Ctr. USDA, ARS, SR P. O. Box 555 Watkinsville, GA 30677 Tel: 404-769-5631 FTS: 250-2425
Urbana, Illinois	Dr. Loyd M. Wax USDA, ARS, NCR Agronomy Department 215 Davenport Hall University of Illinois Urbana, IL 61801 Tel: 217-333-1277 FTS: 958-5541

W. Lafayette, Indiana

Dr. Marvin M. Schreiber
USDA, ARS, NCR
Dept. of Botany & Plant Pathology
G-315 Lilly Hall of Life Science
Purdue University
W. Lafayette, IN 47907
Tel: 317-749-6461

Houma, Louisiana

Dr. Rex W. Millhollon
U.S. Sugarcane Field Laboratory
USDA, ARS, SR
P. O. Box 470
Houma, LA 70361
Tel: 504-872-5042

Beltsville, Maryland

Dr. James L. Hilton
Chairman, Agricultural Environmental
Quality Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301-344-3029
FTS: 344-3029

Dr. Dayton L. Klingman
Chief, Weed Science Laboratory
Agricl. Environmental Quality Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301-344-3873
FTS: 344-3873

Dr. Walter A. Gentner
Agricl. Environmental Quality Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301-344-3537
FTS: 344-3537

Frederick, Maryland

Dr. Richard H. Hodgson
Weed Science Research
USDA, ARS, NER
P. O. Box 1209
Frederick, MD 21701
Tel: 301-663-7132
FTS: 935-7132

St. Paul, Minnesota

Dr. R. N. Andersen
USDA, ARS, NCR
Weed Research Laboratory
Dept. of Agronomy & Plant Genetics
1509 Gortner Avenue
University of Minnesota
St. Paul, MN 55108
Tel: 612-373-0877
FTS: 786-0877

Stoneville, Mississippi	Dr. Chester G. McWhorter Chief, Southern Weed Science Laboratory USDA, ARS, SR P. O. Box 225 Stoneville, MS 38776 Tel: 601-686-2311, Ext. 221 or 222 FTS: 497-2221 or 2222
Columbia, Missouri	Dr. Elroy J. Peters USDA, ARS, NCR Crop Production Research Unit Agronomy Department, Rm. 216 Waters Hall University of Missouri Columbia, MO 65201 Tel: 314-882-2405 FTS: 276-3218
	Dr. Richard J. Aldrich USDA, ARS, NCR Crop Production Research Unit Agronomy Department, Rm. 216 Waters Hall University of Missouri Columbia, MO 65201 Tel: 314-882-2006 FTS: 276-3218
	Dr. Maurice R. Gebhardt Soybean Production Systems Res. Unit USDA, ARS, NCR Bldg. T-12 University of Missouri Columbia, MO 65201 Tel: 314-882-6630 FTS: 276-3170
Lincoln, Nebraska	Dr. Melvin K. McCarty USDA, ARS, NCR Agronomy Department, Rm. 316 Keim Hall University of Nebraska Lincoln, NB 68583 Tel: 402-472-1546 FTS: 622-1546
Reno, Nevada	Dr. Raymond A. Evans Management & Improvement of Semiarid Rangelands in the Western States USDA, ARS, WR University of Nevada 920 Valley Road Reno, NV 89512 Tel: 702-784-6763 FTS: 470-5607

Ithaca, New York	Dr. Dean L. Linscott USDA, ARS, NER Agronomy Department 622 Bradfield Hall Cornell University Ithaca, NY 14853 Tel: 607-256-5404 FTS: 882-4204
Fargo, North Dakota	Dr. D. Stuart Frear Agricultural Chemicals Research: Plants Metabolism & Radiation Research Lab. USDA, ARS, NCR State University Station P. O. Box 5674 Fargo, ND 58102 Tel: 701-237-5771, Ext. 5445 FTS: 783-5445 or 5446
Corvallis, Oregon	Dr. William O. Lee USDA, ARS, WR Dept. of Agronomic Crop Science Oregon State University Corvallis, OR 97331 Tel: 503 754-2821
Charleston, South Carolina	Dr. Howard F. Harrison U.S. Vegetable Laboratory USDA, ARS, SR 2875 Savannah Highway Charleston, SC 29407 Tel: 803 556-0840 FTS: 677-4396
College Station, Texas	Dr. Rodney W. Bovey Brush Control Research USDA, ARS, SR Department of Range Science Texas A&M University College Station, TX 77843 Tel: 713-846-8821, Ext. 238 FTS: 527-1238
Temple, Texas	Dr. H. S. Mayeux, Jr. Grassland-Forage Research Center USDA, ARS, SR P. O. Box 748 Temple, TX 76501 Tel: 817-774-1201 FTS: 736-1201

	Dr. C. J. DeLoach Grassland-Forage Research Center USDA, ARS, SR P. O. Box 748 Temple, TX 76501 Tel: 817-774-1201 FTS: 736-1201
Weslaco, Texas	Dr. Robert M. Menges USDA, ARS, SR P. O. Box 267 Weslaco, TX 78596 Tel: 512-968-5438 FTS: 749-1011, Operator Assist
Logan, Utah	Dr. M. C. Williams Poisonous Plant Research Laboratory USDA, ARS, WR UMC-45, Plant Industry Bldg, Rm. 205 Utah State University Logan, UT 84322 Tel: 801-750-1579, Ext. 7225
Prosser, Washington	Dr. Jean H. Dawson USDA, ARS, WR Irrigated Agricl. Res. & Extn. Center P. O. Box 30 Prosser, WA 99350 Tel: 509-786-3454
Pullman, Washington	Dr. Larry A. Morrow USDA, ARS, WR Dept. of Agronomy and Soils Washington State University Pullman, WA 99164 Tel: 509-335-3624 FTS: 445-3624
	Dr. R. I. Papendick, RL USDA, ARS, NCR 215 Johnson Hall Washington State University Pullman, WA 99164 Tel: 509-335-1551
Kearneysville, West Virginia	Dr. William V. Welker, Jr. Appalachian Fruit Research Station USDA, ARS, NER P. O. Box 179 Kearnesyville, WV 25430 Tel: 304-725-3451-4

National Research Program 20290

AGRICULTURAL CHEMICALS TECHNOLOGY FOR CROP PROTECTION AND MODIFICATION

This basic, multidisciplinary national research program emphasizes the development of new knowledge, new concepts, and new principles on the relationship of chemical structure to biological activity; including the nature, behavior, and fate of chemicals in soils; their mechanisms of entry, movement, activity, selectivity, metabolism, and fate in plants; their performance efficiency; and safety to crops, soils, and nontarget organisms in the environment. This research is essential to the efficient and safe use of pesticides and plant growth modifiers in the development of high-yielding food, feed, and fiber agroecosystems that will maintain the nation's food supply and improve the quality of the environment. This program supports the missions and goals of ARS, S&E and the Department. The intramural research program is organized into 23 projects at 10 locations and is conducted by 30 ARS scientists in cooperation with several Federal agencies, State agricultural experiment stations (SAES), private universities and research institutes, and industrial research organizations. This NRP also supports 5 cooperative extramural research projects by 5 SAES scientists in 3 states and 1 PL480 project by 3 foreign scientists in 1 foreign country. Progress in 1981 was reported in 47 scientific publications.

NPS Contact: W. C. Shaw

Technological Objective 1: New concepts and knowledge for improving the primary evaluation and structure-activity assessments for enhanced development of improved herbicides, fungicides, nematicides, insecticides, and growth regulators that are compatible with a quality environment.

Research Locations:

Berkeley, California	Frederick, Maryland
Peoria, Illinois	Raleigh, North Carolina
New Orleans, Louisiana	Fargo, North Dakota
Beltsville, Maryland	Philadelphia, Pennsylvania

Examples of Recent Progress:

Substituted pyridazinones improve soybean oil quality - Beltsville, Maryland. Substituted pyridazinones reduced linolenic acid levels in soybean oil and also inhibited lipoxygenase. High levels of linolenic acid and lipoxygenase cause soybean oil to develop rancidity, a highly undesirable trait. Substituted pyridazinones provide a chemical tool for improving oil quality in a single crop year compared with the 10 to 20 years required to improve desirable traits by conventional methods of plant breeding.

Membrane expansion is associated with control of basic physiological processes - Beltsville, Maryland. Effects of undissociated organic acids, nitrophenols, and anesthetics on ion permeability, membrane lipid composition, and seed dormancy are reversed by pressure. Reversal by pressure indicates a causal association of membrane expansion, a physical phenomenon, with control of permeability, membrane lipid composition, and seed dormancy.

New herbicides for weed control in crops - Beltsville, Maryland. Seventeen chemicals from 10 industrial cooperators were evaluated on 17 planted species for their herbicidal properties as preemergence, postemergence, and soil-incorporated treatments. Fourteen of the compounds had selective preemergence and seven had selective postemergence properties that warrant further research for the control of weeds in a wide variety of cropping situations. Many compounds included in this study could be used as selective herbicides when applied postemergence to crops but preemergence to weeds. The GAF 614 was promising for preemergence control of weeds in beets. The acetone-O-[D-2-[p-[(α,α,α-trifluoro-p-tolyl)-oxy]phenoxy]oxime appeared effective for pre- and postemergence control of grassy weeds without injuring broadleaved plants including a variety of horticultural crops.

New chemical controls mosquitoes - Albany, California. A simple compound, J2931, prepared by methylation of the screwworm fly chemosterilant, J2644, has proven in continuing field trials with the University of California to be as effective as organophosphate insecticides in controlling growth of California mosquito species (Aedes sp.; 100% control by application of 0.1 kg/ha).

A new insect sterilant discovered - Albany, California. A compound J2922 with a wide range of potentially promising biological activity has been synthesised. It is (a) a potent anti-JH compound with the moth, Galleria sp., (b) a mosquito growth regulator, (c) a most effective sterilant for the female tsetse fly, and (d) in tests at the National Cancer Institute it is active against leukemia in mice. The NCI has begun larger scale testing against solid tumors.

ARS scientists identify the toxic chemical in locoweed that causes loco syndrome in animals - Albany, California. Continued analysis of poisonous range plants has shown that in some locations Senecio sp. contain up to 18% of the toxic pyrrolizidine alkaloids. An alkaloid, swainsonine, which may be responsible for the loco syndrome has been isolated from locoweeds. It has also been demonstrated that herbal teas prepared from the commonly used comfrey leaves and roots contain substantial quantities of toxic pyrrolizidine aklaloids.

Naturally occurring chemicals in plants may provide basis for developing fungicides - Albany, California. Centrolobium sp. are highly resistant to fungal attack. A number of phenolic fungicides, e.g. centrolobine, centrolobol, dimethylpterocarpan, have now been isolated from Centrolobium sp. and identified. These bioactive compounds may provide the basis for the development of new pest control agents.

New American screwworm fly sterilant is effective on Old World screwworm fly - Albany, California. The fly sterilant J2644 has been provided to the Australian C.S.I.R.O. for studies with the Old World Screwworm fly, Chrysomya bezziana. The sterilant activity proved to be as good or even better than that with the American screwworm fly.

New group of safer nematicides discovered - Beltsville, Maryland. Nematicidal activity has been discovered in a new group of analogs that are relatively safe to nontarget organisms. Activity among the more than 100 related compounds has been determined to fall into four classes of activity. In the highest class, there are a number of compounds that are up to 15X more nematicidal than commercially available standard nematicides used as checks. Structure-activity relations studies are underway to improve and refine our grasp of how to predict activity. The most active compounds will be selected for further evaluations on the bases of safety, stability in the soil, and, preferably, lack of phytotoxicity for development of safer nematode controls.

New sequential treatments with chemicals reduce MH residues in tobacco - Beltsville, Maryland. Greenhouse research showed that isodecyl alcohol (isomeric primary aliphatic alcohols, mostly C_{10}) on an equal weight basis is less active than the normal C_{10} or C_8 =+C_{10} mixed aliphatic alcohols for inhibiting growth in terminal bud length on Xanthi-nc tobacco. Cooperative field research with the University of Maryland showed that early treatment of Maryland tobacco with a n-C_{10} alcohol contact sucker control agent followed 5 to 7 days later with maleic hydrazide (MH), a systemic growth inhibitor, at only 1/2 the recommended rate resulted in 99% sucker control. This sequential method of treatment may provide reduced MH residues in cured leaf of tobacco.

Growth regulator enhances herbicide activity - Frederick, Maryland. The growth regulator fluridone synergistically increased the herbicidal injury caused by bentazon when applied as tank mixtures to bean, nutsedge, and Canada thistle. This research demonstrates that herbicidal efficacy can be increased by a single pass treatment of weeds with a herbicide-plant growth regulator mixture.

Technical Objective 2: New and improved knowledge of the nature, behavior, and fate of agricultural chemicals in soils that influence the performance of pesticides and growth modifying chemicals and their safety to crops, soils, and nontarget organisms in the environment.

Research Locations:

Beltsville, Maryland
Stoneville, Mississippi

Examples of Recent Progress:

DBCP persists and moves down in soil over three month period - Beltsville, Maryland. DBCP, a soil fumigant nematicide was recovered from Faceville sand, a soil used for commercial peach production, three months after application. It was recovered from soil plots that were not irrigated, at a depth of one meter. In plots that were irrigated on a regular schedule after application of the fumigant, DBCP was found 10 meters deep. These data point up need for better understanding of behavior of pesticides in soils.

Computer program designed for agricultural research generates journal-quality figures for publications - Stoneville, Mississippi. Designed to completely replace manual drawing of pen-and-ink plots of field data, the program written for a desktop computer, allows scientists to generate and store on tape complex data plots including multicurve plots with labeling, axes, etc. Quality of plots is superior to most hand-drawn figures, and the program can be operated by technicians without prior experience on the computer or programming knowledge.

Rice sterility symptoms related to MSMA herbicide drift times and yields - Stoneville, Mississippi. Experiments simulating arsenical herbicide (used in cotton) drift to neighboring rice fields have shown that sterility and arsenic residues are dramatically affected by time of drift during season. Data allows estimation of yield losses based on visual "straighthead" counts, and shows that MSMA is still circulating in the plant translocation system weeks after application.

Chlorinated compounds are made more biodegradable by UV - Beltsville, Maryland. Four chlorinated compounds: 2,4,5-7, TCDD, PCP and PCB, are degraded slowly in most soils. If aqueous solutions of these compounds are first subjected to ultra violet light in the presence of oxygen and then added to soil, they degrade more rapidly. This suggests that the carbon-chlorine bond, which these compounds contain influences their persistence in soil, has been altered to a structure that is more easily degraded by the soil microflora. There is also cleavage of these chlorinated compounds during irradiation that further decreases their concentration in solution prior to soil disposal. This is a new innovation that can be applied to destruction of hazardous wastes where incineration or land disposal may not be possible or economical.

Vapor pressure controls pesticide volatilization from soil - Beltsville, Maryland. Comparative volatilization of several pesticides from soils was measured in microagroecosystem chambers. Volatilization depended upon the pesticides vapor pressure. Volatilization of higher-vapor-pressure pesticides was high initially and decreased rapidly with time, while volatilization of the lower-vapor-pressure pesticides was lower initially and decreased slowly with time. Knowing the volatilization potential of a pesticide will aid in improving pesticide application and efficacy in no-till farm practices.

Complex organoarsenical compounds present in food crops - Beltsville, Maryland. A variety of food crops were grown on arsenic containing soil and analyzed for water soluble, lipid soluble and protein, cellular arsenic residues. Some crops contained nearly all their arsenic in one of the fractions, while others had arsenic in all fractions. The water soluble arsenic in broccoli, lettuce, and potato flesh was not primarily arsenate, arsenite, methanearsenate or cacodylate, but a more complex organoarsenical compound which gave arsenate after base hydrolysis.

Technological Objective 3: New and improved knowledge on the mechanisms of entry, movement, activity, selectivity, metabolism, and fate of applied pesticides and growth regulators in relation to their effective action in plants and their safety to subsequent crops and nontarget organisms.

Research Locations:

Beltsville, Maryland
Raleigh, North Carolina
Fargo, North Dakota

Examples of Recent Progress:

Herbicides interact with plant membranes - Raleigh, North Carolina. Herbicides absorbed and translocated by plants can partition into and interact with the membranes of all cells with which they come in contact. For some herbicides (chlorpropham, propanil, dinoseb), but not for others (diuron, atrazine), the partitioning results in alterations to the properties of the membranes. These can be measured as changes to fluidity, permeability, and activity of constituent enzymes. The alterations result from interaction with lipoidal rather than proteinaceous components of the membranes. This observation provides a clearer understanding of how certain herbicides kill plants and should be useful in developing new and more selective herbicides.

New technique will reduce maleic hydrazide (MH) residues on tobacco - Raleigh - North Carolina. Field research with a directed spray technique has shown that tobacco suckers can be controlled effectively without having excessive chemical residues. The directed spray technique does not wet all the upper leaf surfaces with the suckering agents as the conventional methods used, but rather wets approximately one-third of the surfaces. The technique utilizes a tankmix of fatty alcohols plus one-half rate of MH applied twice, one week apart. Furthermore, the technique works well with the experimental suckering agents now being considered for registration. The technique is significant because a 60 percent reduction of MH in the cured leaf was achieved and lower pesticide residues will be regarded as favorable by the tobacco industry and improve the demand for US tobacco world-wide.

Substituted phthalimides: a new class of plant growth regulators, Fargo - North Dakota. The availability of synthetic compounds, which mimic the action of endogenous phytohormones, has made the use of growth regulators practical. Synthetic analogs of the naturally occurring auxins, cytokinins, and ethylene have been particularly useful in this regard. To date, however, there has been no report of a synthetic analog of the gibberellins, a class of phytohormones that controls many aspects of plant growth and development. Following a brief report of the effects of the substituted phthalimide AC-94,377 (1-(3-chloro-phthalimido)-cyclohexane-carboxamide) on lettuce, the range of growth-regulating activity of this compound was explored in several, well-defined plant assay systems. AC-94,377 was found to have no auxin or cytokinin activity. Instead, and more importantly, AC-94,377 was found to possess gibberellin-like activity in several assay systems. These results may lead the way to testing AC-94,377 in various agricultural systems where gibberellin-like activity is desired.

Interactions with IAA as the basis for herbicidal activity by grass herbicides - Fargo, North Dakota. A new class of postemergence herbicides is being developed to control grassy weeds such as wild oat, johnsongrass, foxtail, bermudagrass, etc. These herbicides are phenoxy-phenoxy alkanoic acid esters and related compounds, including diclofop-methyl. Diclofop-methyl inhibits the activity of the plant hormone, IAA, and stops growth very rapidly. Growth is stopped not by destruction of plant cell membranes, but by interference with IAA-induced membrane related functions that stimulate plant growth. This information will aid in the development of more effective and selective postemergence grass herbicides through the development of a better understanding of basic chemical structure-biological activity relationships.

Two chlorinated biphenyls identified from the photolysis of a substituted phenylurea herbicide - Fargo, North Dakota. According to recent legal action, monochloro substituted biphenyls are now classified as polychlorinated biphenyls (PCB's). The photolysis of 3-(4-chlorophenyl)-1,1-dimethylurea (monuron) in dilute aqueous solution, results in the formation of 2-chloro and 5-chloro substituted bis(dimethylureido)biphenyl photoproducts. The presence of these materials in the environment may be of some concern with the current interest in residues of PCB's in natural waters and foodstuff. Since some aminobiphenyls have been previously reported as carcinogens, these chlorinated biphenyls or their photobyproducts may need further toxicological evaluation.

Key pesticides converted to N-malonylcysteine conjugates as important terminal crop residues - Fargo, North Dakota. Six out of eleven pesticides thought to be metabolized via an initial glutathione conjugation reaction were converted to N-malonylcysteine conjugates in peanut cell suspension culture. Results were verified in vivo with PCNB in barley, blue green algae, corn, cotton, peanut, and soybean; with EPTC in corn, cotton, and soybean; and with propachlor in soybean. The terminal nature of this type of residue was verified in vitro with PCNB in peanut cell suspension culture and in vivo with soybean treated with propachlor and grown to maturity. This information should aid metabolism chemists in providing data to support registration of pesticides.

Reduced risks of pesticide formulation agent phytotoxicity and environmental contamination - Fargo, North Dakota. Some pesticide formulations may require relatively high contents of surfactants to achieve proper storage properties or to enhance their efficacy in the field. Studies of the degradation of formulation agents (nonionic surfactants) in plants, when other likely components of pesticide formulations are present, suggest that there will not be competition between these materials in plant processes that degrade surfactants unless these formulating agents are very similar structurally. The risks of crop phytotoxicity or of environmental contamination may be minimized by the use of reduced quantities of two or more structurally dissimilar formulating agents to prepare these specialized formulations.

The biology of leafy spurge: factors affecting herbicide translocation - Fargo, North Dakota. Leafy spurge, a serious noxious weed, infests 3 million acres of pasture and rangeland across the central and western portions of the United States, and causes economic losses estimated at $10.5 million annually. Control of leafy spurge with conventional herbicide treatments is difficult, presumably because the applied herbicides fail to reach the extensive, perennial root system. Leaf surface characteristics of 17 biotypes of leafy spurge were examined microscopically. Significant variations among the biotypes were

observed in numbers and distributions of wax platelets. Stomatal differences may affect the ability of the plant to absorb topically applied herbicides. Latex containing cells were characterized microscopically and located within the phloem tissues. These cells may interfere with the movement of chemicals from the shoots to the roots by absorbing herbicides. Aseptically grown roots of leafy spurge have been isolated and grown in nutrient media. Shoot buds were formed and the resulting plants were potted in the greenhouse. This system will be used to study the influence of chemicals on the control of root and shoot buds in vitro, and eventually in the greenhouse and the field.

Improved translocation of 2,4-D in leafy spurge improves control - Fargo, North Dakota. The effects of various cultural and chemical treatments on the translocation of herbicides in leafy spurge have been examined. For example, it was found that decapitation of spurge seedlings greatly enhances basipetal translocation of 2,4-D (4 X control). This effect was transient and was maximal 3 days following decapitation. Other experiments, using morphactins (growth regulators) have shown that these chemicals reduce the basipetal movement of 2,4-D. The results of this research will aid in achieving improved control of leafy spurge with conventional herbicides at a reduced cost to the applicator.

Technological Objective 4: Develop new information on natural bioconstituents and related synthetic compounds that control physiological and biochemical processes for the development of chemicals to modify plant structure and processes.

Research Locations:

Peoria, Illinois	New Orleans, Louisiana
Beltsville, Maryland	Philadelphia, Pennsylvania

Examples of Recent Progress:

Strigol precursors are active as witchweed seed germination stimulants - New Orleans, Louisiana. Thirty compounds which are precursors, analogues, derivatives, or fragments of strigol were prepared and evaluated for activity as germination stimulants for witchweed seed. Of these, seven showed slight activity, while five others showed significant levels of activity. Two of the compounds demonstrating significant activity, 5-ethoxy-3-methyl-2(5H)-furanone, and 3-hydroxy-2,6,6-trimethyl-cyclohex-1-ene-1-carboxaldehyde, are precursors in the strigol synthesis. If these compounds demonstrate similar activity under field conditions, they represent a considerable savings in money and time as each requires only four synthetic steps compared to 18 for strigol.

Alginate seed coatings increase seed hydration rate under low moisture conditions - New Orleans, Louisiana. Alginate film and gel seed coatings, which could serve as carriers for bean seed treatments such as inoculants or fungicides, were shown to offer the added advantage of increasing water imbibition rates, particularly during periods of moisture stress.

Germination regulatory activity of strigol and lactone analogues is not limited to witchweed - New Orleans, Louisiana. Strigol and a two-ring analogue (2-RAS) were found to promote germination in thermally dormant lettuce seeds. Both synthetic and natural compounds in the strigol family have more general regulatory effects on biochemically-induced seed dormancy than the activity previously noted in witchweed germination. Results indicate that the lactone-type strigol analogues may also be effective in inducing germination in other weed seeds having similar survival strategies.

Lettuce seed germination response to strigol and analogues serves as safe bioassay for potential witchweed germination regulators - New Orleans, Louisiana. The germination responses of thermally-stressed lettuce seeds were found to parallel those of witchweed with respect to strigol and two other analogues. A bioassay protocol utilizing lettuce seed thus offers a safe preliminary screening technique for potential germination regulators in witchweed, as well as providing additional information on the mode of action of the regulators and dormancy mechanism.

Mode of action of growth regulator determined - Beltsville, Maryland. Brassinolide (BR) and two analogs were evaluated in several bioassays that are specific in response to plant hormones. These studies were intended to elucidate the mode of action of this highly biologically active compound.

The data suggest that (1) BR interacts with auxins to strongly synergize their effects, (2) the responses to BR and gibberellins within the same test system, are independent, take place simultaneously and, thus, are additive, (3) BR, in the absence of exogenous cytokinins, induces either a weak or no response in cytokinin test systems, (4) ABA interacts strongly with and reverses the growth effects of BR.

Technological Objective 5: Improved automated search, storage, and retrieval systems for relating chemical structure and biological activity of pesticides and growth regulators, including their nature, behavior, and fate in all aspects of the environment.

Research Locations:

Beltsville, Maryland
Frederick, Maryland

Examples of Recent Progress:

Mitchell PGR file online - Frederick, Maryland. This file of 6,600 compounds evaluated by Dr. John W. Mitchell can be accessed and queried for both chemical and biological information by local computer terminal. It represents an important step in making available an ARS-wide chemical-biological data base for automated structure-activity searching.

P U B L I C A T I O N S

Albany, California

Eslyn, W. E., J. D. Bultan, and L. Jurd. 1981. Decay inhibition by extractives from tropical hardwoods. Phytopathology. 71:521-524.

Jurd, L. 1981. Reactions of 4-hydroxycoumarin with flavylium salts. J. Heterocyclic Chem. 18:429-430.

Jurd, L. and R. Y. Wong. 1981. New quinolinone alkaloids from the heartwood of Euxylophora paraensis. Aust. J. Chem. 34:1625-1632.

Jurd, L. and R. Y. Wong. 1981. Quinones and quinone methides. VIII Oxidation products of the screwworm chemosterilant, 2,4-bis(1,1-dimethylethyl)-6-(4-methoxyphenylmethyl)phenol. Aust. J. Chem. 34:1633-1644.

Jurd, L. and R. Y. Wong. 1981. Quinones and quinone methides. IX Oxidation of 2,4-bis(1,1-dimethylethyl)-6-(4-methoxphenylmethyl)-phenol in alcoholic solvents: monomeric products and the crystal structure of an unusual dimer, 2-[3,5-bis(1,1-dimethylethyl)-2-[methoxy(4-methoxyphenyl)methoxy]phenoxy]-1,5-bis(1,1-dimethylethyl)-3-[methoxy(4-methoxyphenyl)methyl] benzene. Aust. J. Chem. 34:1645-1654.

Nes, W. D., M. E. Benson and E. Heftmann. 1981. The location of the methylol groups in sapogenol C and erythrodiol and its biosynthetic significance. Phytochemistry. 20:2299-2300.

Rawlins, S. C. and L. Jurd. 1981. Influence of the mode of administration of benzylphenols and benzyl-1,3-benzodioxoles on screwworm fertility. J. Econ. Entom. 74:215-217.

New Orleans, Louisiana

Connick, W. J., Jr., and A. B. Pepperman, Jr. 1981. Preparation, isolation and high performance liquid chromatographic separation of diastereomers of a strigol analogue. J. Agric. Food Chem., 29, 984-986.

Frank, A. W. 1981. Condensation of B-cyclocitral with benzaldehyde. J. Heterocycl. Chem. 18(3), 549-554.

Pepperman, A. B. 1981. An improved yield preparation of 3-oxo-2,6,6-trimethylcyclohex-1-ene-1-carboxylic acid - an important intermediate in the synthesis of strigol. J. Organic Chem., 46, 5039-41.

Beltsville, Maryland

Ashworth, E. N., M. N. Christiansen, and J. B. St. John. 1981. Effect of temperature and BASF 13 338 on the lipid composition and respiration of wheat roots. Plant Physiol. 67:711-715.

Ashworth, E. N., J. B. St. John, M. N. Christiansen, and G. W. Patterson. 1981. Characterization of wheat root phospholipids using high performance liquid chromatography. J. Agric. Food Chem. 29:879-881.

Campbell, T. A., W. A. Gentner, and L. L. Danielson. 1981. Evaluation of herbicide interactions using linear regression modeling. Weed Sci. 29:378-381.

Doyle, R. C., D. D. Kaufman, G. W. Burt and L. Douglas. 1981 Degradation of cis-permethrin in soil amended with sewage sludge or dairy manure. J. Agric. Food Chem. 29:412-414.

Dragun, J., and C. S. Helling. 1981 Evaluation of molecular modelling techniques to estimate the mobility of organic chemicals in soils: II. Water solubility and the molecular fragment mobility coefficient. Land Disposal: Hazardous Waste. Proc. 7th Ann. Res. Symp. SW Res. Inst., U.S. Environmental Protection Agency. EPA-600/9-81-002B. pp. 58-70.

Feldmesser, J., H. Jaffe, P. A. Giang, and G. Wolfhard. 1981. Experimental controlled-release formulations of a nematicidal amine. Invited Paper. Proc. Eighth International Symposium on Contr. Release of Bioactive Materials, pages 147-148.

Helling, C. S., and J. Dragun, 1980. Soil leaching for toxic organic chemicals. In Test protocols for Environmental Fate and Movement of Toxicants. Proc. Symp. Assoc. Off. Anal. Chemists, pp. 43-88 (A81).

Hornick, S. B., D. D. Kaufman and R. L. Chaney. 1981. Agricultural use of textile wastes. Symposium proceedings, the textile industry and the environment. Amer. Assoc. Textile Chemists and Colorists. Washington, D.C. pp. 9-16.

Jordan, E. G., D. D. Kaufman and A. J. Kayser. 1982. The effect of soil temperature on the degradation of cis,trans-permethrin in soil. J. Environ. Sci. Health. Sect. B 17(1):1-17.

Kaufman, D. D. and S. B. Hornick. 1981. Movement and fate of hazardous materials in soil systems. In: Proc. Nat. Conf. on Risk and Decision Analysis for Hazardous Waste Disposal. Hazardous Materials Control Research Institute. Silver Spring, MD pp. 28-41.

Kaufman, D. D., B. A. Russell, C. S. Helling, and A. J. Kayser, 1981. Movement of cypermethrin, decamethrin, permethrin, and their degradation products in soils. J. Agr. Food Chem. 29:239-245.

Kochansky, J. P., J. Feldmesser, and W. E. Robbins. 1981. Control of nematodes and other helminths. U. S. Patent No. 4,273,768.

Mandava, N. B., G. J. Kapadia and J. F. Worley. 1981. Inhibition of plant growth by phenethylamines and tetrahydroisoquinolines. J. Natural Products. 44:94-100.

Mandava, N. B., J. M. Sasse and J. H. Yopp. 1981. Brassinolide, a growth-promoting steroidal lactone II. Activity in selected gibberellin and cytokinin bioassays. Physiol. Plant. 53:453-461.

Nash, R. G. 1981. Phytotoxic interaction studies-techniques for evaluation and presentation of results. Weed Sci. 29:147-155.

Pillai, P. and J. B. St. John. 1981. Lipid composition of chloroplast membranes from weed biotypes differentially sensitive to triazine herbicides. Plant Physiol. 68:585-587.

Woolson, E. A. 1981. Formation of arsenite in lead arsenate or calcium arsenate mixtures. J. Environ. Sci. Health B16(2):131-140.

Woolson, E. A. and A. R. Isensee. 1981. Soil residue accumulation from three applied arsenic sources. Weed Sci. 29(1):17-21.

Yopp, J. H., N. B. Mandava and J. M. Sasse. 1981. Brassinolide, a growth-promoting steroidal lactone I. Activity in selected auxin bioassay. Physiol. Plant. 53:445-453.

Stoneville, Mississippi

Richard, E. P., H. R. Hurst and R. D. Wauchope. 1981. Effects of simulated MSMA drift on rice (Oryza sativa) growth and yield. Weed Sci. 29(3):303-308.

Raleigh, North Carolina

Hsiao, A. I., A. D. Worsham, and D. E. Moreland. 1981. Effects of sodium hypochlorite and certain plant growth regulators on germination of witchweed (Striga asiatica) seeds. Weed Sci. 29:98-100.

Hsiao, A. I., A. D. Worsham, and D. E. Moreland. 1981. Regulation of witchweed (Striga asiatica) conditioning and germination by dl-strigol. Weed Sci. 29:101-104.

Hsiao, A. I., A. D. Worsham, and D. E. Moreland. 1981. A bioassay for dl-strigol using witchweed [Striga asiatica (L.) Kuntze] seed germination. Z. Pflanzenphysiol. 104:1-8.

Huber, S. C. and D. E. Moreland. 1981. Co-transport of potassium and sugars across the plasmalemma of mesophyll protoplasts. Plant Physiol. 67:163-169.

Manring, J. A. and D. E. Moreland. 1981. Effects of chlordecone on isolated rat liver mitochondria. Toxic. Appl. Pharmacol. 59:483-488.

Maury, W. J., S. C. Huber, and D. E. Moreland. 1981. Effects of magnesium on intact chloroplasts. II. Cation specificity and involvement of the envelope ATPase in (sodium) potassium/proton fluxes across the envelope. Plant Physiol. 68:1257-1263.

Moreland, D. E. 1981. Interaction of perfluidone with mitochondrial, thylakoid, and liposome membranes. Pest. Biochem. Physiol. 15:21-31.

Fargo, North Dakota

Donald, William W. 1981. EPTC effects in the lettuce (Lactuca sativa) hypocotyl bioassay for gibberellins. Weed Science. 29:490-499.

Gorecka, K., R. H. Shimabukuro and W. C. Walsh. 1981. Aryl hydroxylation: A selective mechanism for the herbicides, diclofop-methyl and clofop-isobutyl, in gramineous species. Physiol. Plant. 53:55-63.

Lamoureux, G. L., J. M. Gouot, D. G. Davis and D. G. Rusness. 1981. Pentachloronitrobenzene metabolism in peanut. 3. Metabolism in peanut cell suspension cultures. J. Agric. Food Chem. 29:996-1002.

Lamoureux, G. L. and D. G. Rusness. 1981. Catabolism of glutathione conjugates of pesticides in higher plants. ACS Symposium Series 158: 133-164.

Paulson, G. D., J. M. Giddings, C. H. Lamoureux, E. R. Mansager and C. B. Struble. 1981. The isolation and identification of ^{14}C-sulfamethazine {4-amino-N-(4,6-dimethyl-2-pyrimidinyl[^{14}C-] benzenesulfonamide} metabolites in the tissues and excreta of swine. Drug Metabolism and Disposition 9(2): 142-146.

Reilly, C. C. and G. L. Lamoureux. 1981. The effects of the fungicide, iprodione, on the mycelium of Sclerotinia sclerotiorum. Phytopathology. 71:722-727.

Still, G. G., H. M. Balba and E. R. Mansager. 1981. Studies on the nature and identity of bound chloroaniline residues in plants. J. Agric. Food Chem. 29:739-746.

Suttle, J. C. 1981. Effect of polyamines on ethylene production. Phytochemistry. 20:1477-1480.

Tanaka, F. S., R. G. Wien and B. L. Hoffer. 1981. Biphenyl formation in the photolysis of 3-(4-chlorophenyl)-1, 1-dimethylurea (monuron) in aqueous solution. Journal of Agricultural and Food Chemistry. 29:1153-1158.

Tanaka, F. S., R. G. Wien and E. R. Mansager. 1981. Survey for surfactant effects on the photodegradation of herbicides in aqueous media. Journal of Agricultural and Food Chemistry. 29:227-230.

PRINCIPAL CONTACTS - NRP 20290

Berkeley, California -

Dr. Arthur I. Morgan, Jr.
Western Regional Research Center
USDA, ARS, WR
800 Buchanan Street
Berkeley, CA 94706
Tel: 415 486-3506
FTS: 449-3506

Dr. L. Jurd
Natural Products Chemistry
Western Regional Research Center
USDA, ARS, WR
800 Buchanan Street
Berkeley, CA 94706
Tel: 415 486-3695
FTS: 449-3695

Peoria, Illinois -

Dr. William H. Tallent
Northern Regional Research Center
USDA, ARS, NCR
1815 N. University Street
Peoria, IL 61604
Tel: 309 685-4011
FTS: 360-4251

Dr. William M. Doane
Northern Regional Research Center
USDA, ARS, NCR
1815 N. University Street
Peoria, IL 61604
Tel: 309-685-4011
FTS: 360-4312

New Orleans, Louisiana -

Dr. Ivan W. Kirk
Southern regional Research Center
USDA, ARS, SR
P. O. Box 19687
New Orleans, LA 70179
Tel: 504-589-7511
FTS: 682-7511

Dr. Sidney F. Vail
Cotton Textile Chemistry Laboratory
Southern Regional Research Center
USDA, ARS, SR
P. O. Box 19687
New Orleans, LA 70179
Tel: 504 589-7067
FTS: 682-7067

Beltsville, Maryland -

Dr. James L. Hilton
Chairman, Agricultural Environmental
Quality Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301 344-3029
FTS: 344-3029

Dr. Dayton L. Klingman
Chief, Weed Science Laboratory
Agricl. Environmental Quality Laboratory
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301 344-3873
FTS: 344-3873

Dr. Phillip C. Kearney
Chief, Pesticide Degradation Laboratory
Agricl. Environmental Quality Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301 344-3076 or 3082
FTS: 344-3076 or 3082

Dr. Julius Feldmesser
Nematology Laboratory
Plant Protection Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301 344-3662
FTS: 344-3662

Dr. James D. Anderson
Chief, Plant Hormone Laboratory
Plant Physiology Institute
USDA, ARS, NER
Beltsville, MD 20705
Tel: 301 344-3061
FTS: 344-3061

Frederick, Maryland -

Dr. Richard H. Hodgson, RL
Weed Science Research
USDA, ARS, NER
P. O. Box 1209
Frederick, MD 21701
Tel: 301 663-7132
FTS: 935-7132

Raleigh, North Carolina -

Dr. Donald E. Moreland, RL
USDA, ARS, SR
Williams Hall
North Carolina State University
P. O. Box 5155
Raleigh, NC 27607
Tel: 919 737-2661
FTS: 672-4408

Fargo, North Dakota -

Dr. D. Stuart Frear, RL
Agricl. Chemicals Research: Plants
Metabolism & Radiation Research Lab.
USDA, ARS, NCR
P. O. Box 5674
Fargo, ND 58102
Tel: 701 237-5771
FTS: 783-5445

Wyndmoor, Pennsylvania -

Dr. Herbert L. Rothbart
Eastern Regional Research Center
USDA, ARS, NER
600 East Mermaid Lane
Philadelphia, PA 19118
Tel: 215 247-5800
FTS: 489-6593

Dr. Donald D. Bills
Eastern Regional Research Center
USDA, ARS, NER
600 East Mermaid Lane
Philadelphia, PA 19118
Tel: 215 247-5800
FTS: 489-6580

Special Research Program

PILOT TESTING OF ALTERNATIVE METHODS FOR PEST CONTROL

Technological Objective: The objective is to rapidly advance newly emerging technology that would (1) reduce net losses from pests; (2) reduce the adverse effects of pest control technology on the environment, either by improving current technology or by developing new technology; and (3) reduce the hazard to humans of pest control technology.

The purpose of this Special Research Program is to promote the development and commercial use of pest management methods that would affect neither people nor the environment adversely. For example, the new technology must be free of the problems that attend use of many of the broad-spectrum insecticides, such as hazards to humans, biomagnification, and toxicity to nontarget species. To a limited extent, this program includes systems research to optimize use of conventional pesticides.

NPS Contact: Waldemar Klassen

Note: Scientists at various locations submit pilot research proposals for alternative methods in order to compete for funds from the Administrator's Pilot Testing Fund of $1.67 million per year. Projects currently are funded at the following locations:

Stuttgart, Arkansas
Davis, California
Riverside, California
Shafter, California
Denver, Colorado
Fort Collins, Colorado
Newark, Delaware
Gainesville, Florida
Byron, Georgia
Manhattan, Kansas
Beltsville, Maryland
East Grand Forks, Minnesota
Starkville, Mississippi
Stoneville, Mississippi
Columbia, Missouri
Reno, Nevada
Las Cruces, New Mexico
Ithaca, New York
University Park, Pennsylvania
Florence, South Carolina
College Station, Texas
Kerrville, Texas
Madison, Wisconsin
St. Croix Island, Virgin Islands

NER-82-6 - Feasibility of controlling the gypsy moth biologically by augmenting its populations when very low (latent) - Newark, Delaware. The pilot study has three main objectives: (1) To learn if augmenting of gypsy moth populations during latency can keep natural enemy populations higher than they would be otherwise; (2) determine if maintaining populations of natural enemies would result in preventing gypsy moth outbreaks; and (3) to monitor parasitism and other factors during latency so that their effects on gypsy moth populations, especially the stages of rapid increase and outbreak, might be determined.

The basic work plan is relatively simple: Ecologically similar paired plots (treatments and controls), with latent populations of gypsy moth would be selected, and gypsy moth egg masses would be introduced annually on the treatment plots. Thereafter, comparisons would be made of defoliation levels and pest-natural enemy populations in the treated (egg masses introduced) and control (natural host population) plots.

Most of the laboratory work is being done at the Beneficial Insects Research Laboratory, Newark, Delaware. To minimize travel expenses and the possible effects of topography on the results, the field plots have been located on the coastal plain in southern or central New Jersey. (In cooperation with New Jersey Department of Agriculture.)

Contact: R. W. Fuester

NER 81-1 - New cultural practices to protect winter wheat production evaluated in actual farm situations of the Northeastern Region - University Park, Pennsylvania. The cultural practices are based on 5 basic hypotheses:

(1) Modern, shorter varieties of wheat should be yield responsive and lodging resistant at N levels substantially higher than those presently used.

(2) Wheat seeded in 5 in rows is more efficient in utilizing resources and should yield more than wheat in 7 in rows.

(3) Deeper seedings (1.5 in) than at 0.75 in should reduce lodging and may increase yields.

(4) Higher seeding rates should increase the amount of highly productive primary tillers in a stand and consequently increase yields.

(5) Intensity of various diseases may increase under some management systems and rotation schedules and thereby limit wheat yields.

Experiments were located on 10 farms in two counties. Fields were selected so that wheat followed each of 6 major crops, and it was sown in accordance with the above hypotheses. Yield average was 63 bu/A over all treatment A locations --the State average was 36 in 1981. One location averaged 80 and individual treatments averaged up to 106 bu/A. Response to narrower rows was the most consistent--5-inch rows produced 5 to 18 bu/A more than 7-inch rows, or $43.2/A more. If half on the 676,000 A of wheat in the NE Region were planted in 5-inch rows, gross return would be $14.6 million. Increasing the spring N application rate above 30 lb/A did not increase yields. On five farms, the highest yields were from fields without spring N. Responses to increased seeding rates and depth were less consistent among the farms. However, late fall seeding benefited from shallower planting depth and higher seeding rates. Bushel weight decreased consistently as spring N rates increased. N also increased lodging as did shallow seedling and 7-inch row spacing. Diseases, weeds, and insects were monitored in all plots. No serious insect damage or weed problems were observed. However, powdery mildew and Septoria blotch were always increased

by one management practice--increased N. Root rot was rated on two farms following wheat, and was more severe with deeper seeding. At two locations, meetings were held to discuss wheat management with local producers.

Contact: H. Marshall

NER-78-1 - Feasibility of managing golden nematode population densities by integration of control technologies - Ithaca, New York. A study underway for the past 4 years shows that populations of the golden nematode of potatoes can be substantially suppressed under certain management systems. Systems that include growing resistant varieties, growing nonhost alternate crops, and using nematicides sparingly have been developed to keep nematode densities below levels detectable by regulatory surveys. These systems can be employed to limit spread in areas where the nematode occurs and may prevent its establishment in noninfected land if spread should occur. Under one management system, monocultures of a resistant potato cultivar reduced the nematode density 92 percent. The relative effectiveness of the several systems has not yet been fully assessed. A detailed analysis and report will follow the final year (1982) of the pilot study.

Contact: B. Brodie

NER-77-4 - Feasibility of using of N-substituted alkyl amides and amines to manage plant parasitic nematodes - Beltsville, Maryland. This is a feasibility study to determine how the project's discovery of high nematicidal activity in a number of juvenile hormone analog-like amines and amides may be put to practical use. These compounds show little or no toxicity to mammals. Major objectives: (1) Stabilize compounds for use under practical field conditions. This involves primary *in vitro* evaluations. (2) Use under greenhouse conditions to determine nematicidal activity in soils and around plants. (3) Determine effects on plants. (4) Determine residues in exposed plants and soils.

Objectives 2 through 4 can only be met after objective 1 because these compounds are rapidly bound or degraded in soil.

Progress:

The most promising nematicidal amine NNDD (*N*,*N*-dimethyldodecanamine) has been used in this work. During 1981 a new formulation, a new means of preparing the formulation (as pellets), and a new method for cutting the pellets were devised, and the pellets were evaluated under *in vitro* conditions. NNDD was mix-melted into ethylene/vinyl acetate copolymer, and the soft mixture was inserted into 3-mm-ID polyethylene tubes. Pellets varying in thickness by 20-micron increments were cut from the filled tubes with a sliding microtome. The pellets were evaluated for controlled (or extended) release capability. Evaluations entailed alterately exposing the pellets for 48 hr to water-quartz sand-nematode mixtures and drying them for 24 hr under good exhaust. The most effective pellets were 480 microns thick. They retained nematicidal activity over four 48-hr cycles plus three 24-hr drying cycles, a total of more than

8 days. Further investigations are aimed at extending the efficacy period, and determining the effect of pellet size on the extension.

Contact: J. Feldmesser

NCR-82-2 - Evaluation of the entomopathogenic fungus Nomuraea rileyi as a bioinsecticide - Columbia, Missouri. The objectives of the pilot study are (1) to evaluate the efficacy of the fungus in protecting soybean; (2) to characterize and establish quality-control criteria on viability, insecticidal activity, and safety of production batches of conidia; and (3) to develop sensitive, specific techniques to identify isolates and monitor for presence of Nomuraea rileyi.

Field tests have been planned for six States in the region, and involve the cooperation of industry, USDA, and State scientists under the S 135 program. An experimental use permit has been granted for the fungus, which is now being produced by industry in amounts sufficient for the test. The organism has been subjected to quality control procedures and has been distributed to the participants. The object of this phase of the project is to induce epizootics against lepidopterous pests of soybean in the field.

Laboratory research includes identification of the fungus strains, early field detection, and feasibility of use tests. In those tests an attempt will be made to anticipate problems that will arise and find solutions for them beforehand.

Contact: C. M. Ignoffo

NCR-81-1 - Development of practical methods for applying Bacillus thuringiensis (B.t.) to stored grain and oilseeds for moth control - Manhattan, Kansas. The object of this pilot study is (1) to develop practical techniques for uniformly applying B.t. formulated as a dust of wettable powder (WP) on grains stored on farm and in commercial warehouses and (2) to evaluate the effectiveness of the formulations in controlling the Indian meal moth and the almond moth.

Progress:

Cooperation was established with 60 farmers and one elevator operator in Nebraska, Kansas, Iowa, Illinois, and Oklahoma to treat wheat and corn in ca. 180 bins with B.t during 1980 and 1981. Tests were initiated to determine whether spray volumes can be reduced from the currently recommended rate of 7.5 gal/100 bu without sacrificing efficacy. The WP was applied by both auger and rake-in methods with water volumes of 3 and 1 gal/100 bu. The dust was applied by auger and rake-in methods as well as by use of aeration fans. The treated bins have been sampled, and the uniformity and toxicity of the bacterial deposits are being evaluated. The bins are being monitored to evaluate long-term performance of the treatment methods.

During the 1981 season B.t. reduced but did not eliminate moth infestations in the treated bins. This finding suggests that either the dosage of the treatment or the depth of the treated surface layer of grain needs to be increased. In

Illinois infestations were reduced by ca. 54 percent; in Iowa and Nebraska, by ca. 77 percent; and in an elevator in Oklahoma, by ca. 22 percent. Extensive cross-infestation from adjacent untreated bins caused the poor performance in the elevator. In Oklahoma and Kansas infestations were too erratic to demonstrate any measurable control.

No consistent differences were observed between the performances of dust and WP formulations, or between different water volumes used for the WP. Laboratory tests using reduced water volumes have not demonstrated any reduction in effectiveness of B.t. on wheat and corn. None of the water volumes tested, including the label rate of 7.5 gal/100 bu, have caused any crusting or molding of surface grain in the tests.

Initial bioassays indicate that populations of Indian meal moths collected from the test bins differ in susceptibility to B.t. The extent of the differences, have not been ascertained but may account for some of the variation in performance.

Contact: W. H. McGaughey

NCR-80-1 - Development of new ways to detect and control storage insects by the combined use of physical, chemical, and biological agents - Madison, Wisconsin. The objective of this study is to develop integrated programs for detecting and controlling storage insects. Efforts focus on insect trap design, trap placement, and improvement of trap efficacy by use of food attractants and sex pheromones. Insect control agents such as chemical pesticides, oils, insect hormones, and insect pathogens may be incorporated into the trap design or used separately in the stored grain ecosystem.

Progress:

Field and laboratory studies confirmed that the natural ratio (1:2) of 1-methylbutyl(E)-2-methyl-2-pentenoate (component D_1) and 1-methylbutyl-(E)-2,4-dimethyl-2-pentenoate (component D_2) in the pheromone of the lesser grain borer, Rhyzopertha dominica, is superior to other ratios in causing the borers to aggregate. In quantitative tests, grain-probe traps containing very high levels of the pheromone caught significantly less R. dominica than control traps, a finding that suggests a dispersive or epideictic effect of the pheromone when populations are high.

A variety of oils, oil processing by-products, and candidate repellents were evaluated for their effects on insect behavior. Oat oil and certain components of oat oil were effective attractants for Oryzaephilus surinamensis, the sawtoothed grain beetle, and Tribolium spp. Certain by-products of soybean oil processing were useful toxicants and repellents for grain weevils when applied to grain. The oils appeared to be effective in conjunction with perforated grain-probe insect traps.

A new, plastic, reusable grain-probe trap was developed for use with pheromones and/or repellents applied to grain, and is now commercially available. The

traps have been used successfully with the aggregation pheromone of the lesser grain borer and with a variety of vegetable oil repellents. These results will aid in insect monitoring and control and in maintaining the quality of grain.

Field trapping tests with Trogoderma pheromones for trapping the khapra beetle, T. granarium, and other dermestids have continued in cooperation with APHIS and other agencies. A monitoring program for Trogoderma spp. was established for military subsistence warehouses. Traps have been improved by the addition of oat and wheat germ oil to the pheromone bait.

Contact: W. Burkholder

SR-82-1 - Management of cattle grubs - Kerrville, Texas. The common cattle grub, Hypoderma lineatum and the northern cattle grub, Hypoderma bovis, reduce hide value, milk flow, and weight gain. The pilot study has the following objectives:

(1) Determine if systemic insecticides alone or followed by release of sterile males will suppress or eliminate a defined population of cattle grubs.

(2) Relate number of cattle grubs in cattle with benefits and economic gains to the producer, feeder, processor, and consumer.

This joint U.S.-Canadian study was initiated with the establishment of a field laboratory at Browning, Montana. The study area in the United States will cover about 850 square miles immediately east of Glacier National Park and south of the Montana-Alberta, Canada, border and covers the northwestern part of the Blackfeet Indian Reservation. A General Cooperative Agreement has been finalized with the Blackfeet Tribal Business Council, which will facilitate the hiring of technical assistance for the program. The Tribal Council has passed a resolution approving this agreement and has been extremely helpful in initiating the study. Personnel from the Bureau of Indian Affairs have also been very helpful in coordinating efforts and providing support to the study. Efforts are currently under way to confirm the inventory of cattle within the study area, which will be treated this fall with systemic insecticides. The ARS scientist, Dr. P. Scholl, on the project has been assigned to Lethbridge, Alberta, Canada, where he works in close cooperation with Canadian scientists.

Contact: S. E. Kunz

SR-82-6 - Use of vetch as cover crop in irrigated pecan orchards to maintain beneficial insects that control pest insects of pecans - Byron, Georgia. If pecan growers can avoid using insecticides against aphids in the early spring, applications of insecticides in most years would not be necessary before June, July, or even mid-August. A promising biological control system for pecan aphids has been developed, using the naturally occurring aphid predator the convergent lady beetle, Hippodamia convergens Guerin-Meneville, and a number of other beneficial species.

The convergent lady beetle is easily reared in extremely large numbers on the pea aphid, Acyrthosiphon pisum (Harris), which infest vetch (Vicia spp.), a legume. Pea aphids will not feed on pecan trees. In the spring two generations of convergent lady beetles develop on pea aphids and then migrate into pecan trees. There, the beetles control three species of leaf-feeding pecan aphids, the black margined aphid, Monellia caryella (Fitch), Monelliopsis nigropunctata (Granovsky), and the black pecan aphid, Melanocallis caryaefoliae (Davis). The convergent lady beetle feeds readily on and reproduces normally on all three aphid species and is the most abundant lady beetle found in pecan trees. Populations of convergent lady beetles fluctuate greatly because they are semi-arboreal, are prone to migration, and, under the presently used pecan management practices, usually originate outside of pecan orchards.

Convergent lady beetles are stimulated to move into pecan trees by the presence of pecan aphids and honeydew on the foliage and by the decline of pea aphids on dying vetch. Vetch is a candidate cover crop for pecan growers who wish to supplement the nitrogen supply to their trees and to improve the condition of the soil in the orchards. In addition, vetch aids in soil-moisture retention by forming a thick mat of straw when it dies. Vetch is also a good honey flow crop for beekeepers and a potential seed or forage crop for growers. It is believed that up to one-half of the presently used amounts of insecticides may not be required if H. convergens can be effectively maniuplated within pecan orchards.

Pine Knoll Plantation, Sumter Co., Georgia, a 100-acre orchard of 60-year-old pecan trees, was selected for testing the effectiveness of the biocontrol system. The test includes 10-acre replicates of mowed sod (check), Cahaba White vetch, and arrowleaf clover treatments. Legumes were planted; and a weather station, office space, and lab facility established at the test site in fall and winter of 1980. Legume forage production was excellent in 1981. Clover and vetch dry forage yields were 6,821 and 4,963 lb/A, respectively. Forage N content was 2.7 percent for clover and 3.2 percent for vetch. Total N contained in the clover and vetch forage was 185 and 158 lb N/A, respectively. Farm machinery was harmful to vetch and clover seedlings, but both recovered well after nut harvest. Vetch and clover seeded well in 1981, and good second generation stand of both legumes resulted. Counts revealed the presence of 10 genera of nematodes. No changes were observed in nematode levels in the treatments or check for a 12-month period. Sampling for predator populations on legumes and trees and for pecan aphid levels begins in spring of 1982.

Contact: W. L. Tedders

SR-81-1 - Potential of an IPM scheme to control house flies and other filth-breeding flies at poultry farms, with special emphasis on the use of the parasitic wasp Spalangia endius - Gainesville, Florida. House flies and related flies, which are an annoyance and potenial health hazard to humans and animals, breed in tremendous numbers in poultry manure. Unfortunately, current control practices are inefficient and often ineffective. These flies, particularly house flies, can rapidly develop resistance if subjected to severe selective

pressure from chemicals. Also, extensive use of pesticides can result in environmental contamination.

The main objective of this study is to incorporate Spalangia endius into an economically sound IPM scheme for controlling flies, mainly at poultry facilities but also at other types of farm and agricultural complexes. The main emphasis is on sanitation, drainage, baits, and release of parasites.

The pilot study has been expanded from six to seven caged layer installations with a total of ca. 231,000 birds. From February 1981 through March 1982, the density of the adult fly population at each installation was monitored weekly with a modified scudder grid. The percentage parasitism was also monitored weekly by microscopic examination of wild fly pupae collected at the installations.

The surveys at six installations showed that the cold weather in January reduced the adult populations to a low level. However, during March, April, and May, due to warm weather and the presence of pupae, the adult population exploded. During July, August, and September, the coning of the manure as well as the high percentage of parasitism reduced the fly population to a low level. With the onset of cold weather in October, the side curtains of the installations were dropped to maintain a high temperature and reduce the cost of food conversion by the birds. The curtains reduced the air flow, preventing the drying and coning of the manure. Since the parasites are apparently unable to locate the larvae and/or pupae in damp or wet manure, the percentage parasitism dropped and the fly population again increased to a high level, peaking in late December.

The seventh installation was an environmentally controlled installation (German House), and the manure was scraped daily into a concrete holding tank. The fly population remained low throughout the year.

The surveys indicated that parasite release should be delayed in 1982 until late August or early September. Therefore, at three of the installations, parasite releases will begin at that time of year and continue until the curtains are dropped; then, areas of larval breeding will be spot-treated with a larvicide to prevent the March, April, and May adult fly explosion. During these 3 months, adult and larval populations and percentage of parasitism will be monitored. One owner uses insecticides at regular intervals, so his installation will serve as an untreated check.

Contact: P. B. Morgan

SR-81-2 - Management of Heliothis spp. in cotton with augmentative releases of Trichogramma - Stoneville, Mississippi. Release of the egg parasite Trichogramma pretiosum at rates of 40,000 to 50,000 adults/A resulted in up to 60 to 80 percent. Parasitism of Heliothis spp. eggs in cotton, and the average from June to August was 35 percent. Parasitism in nonrelease areas was less than 4 percent. Yield (lb lint/A) was numerically greater (670 lb/A) where Trichogramma was released (6 fields) than in insecticide treated checks

(6 fields) or untreated check fields (8 fields). However, this difference approached significance ($P<0.30$) only between the release fields and untreated checks outside the community (672 lb lint/A vs. 516 lb lint/A. Differences were more pronounced ($P<0.07$) in number of undamaged bolls/acre. The Heliothis spp. populations were low in 1981, averaging only 500 eggs/A during the F_2 generation, 1,000 eggs/A during the F_3 generation, and about 5,000 eggs/A during the F_4 generation; for this reason, perhaps, differences in yield between the treatments were not directly attributable to the Heliothis spp. population.

Season long D-vac data showed a significantly higher number (5 percent level) of total entomophagous arthropods per acre for the Trichogramma release fields than for the treated checks. Populations of major predators of Heliothis spp. (Geocoris spp., Orius spp., spiders, lacewings, lady beetles, and damsel bugs), as determined by both D-vac and drop cloth data, were significantly higher ($P<0.05$) in release fields than in treated checks. Larval parasitism, as determined from larval collection from all fields during the period mid-June to August, averaged 23 percent and varied little between treatments. Microplitis croceipes accounted for 90 percent of total larval parasitism. Bollworms represented 85 percent of all Heliothis larvae collected throughout the summer.

Favorable weather conditions combined with an early cotton crop resulted in a resurgence of the boll weevil, and insecticides were applied to many fields beginning in mid July. Suppression/yield data involving releases of Trichogramma for controlling Heliothis spp. was undoubtedly influenced by the boll weevil presence, and measures were taken for its control. Insecticide applications for Heliothis larvae in release fields and treated checks averaged 2.3 (includes application of nuclear polyhedrosis virus) and 3.8, respectively. Other applications were made in all fields to control the boll weevil. Because of the predetermined release rates and interval for the Trichogramma treatment, these applications were the most expensive control measure utilized.

Trichogramma was released weekly as planned; however, malfunctioning of the aerial release devices resulted in erratic release rates until corrected in early July. All parasite production goals were met, and no difficulties were encountered in parasite programming and transportation of the parasites.

Pheromone traps for determining and predicting the seasonal occurrence of Heliothis spp. populations were monitored from March to November 1981. Data collected in Portland indicated the possibility of long range migration by bollworms into the community. The utility of the MOTHZV model as an aid in synchronizing Trichogramma releases with oviposition periods was validated. Specifically, the lack of a tobacco budworm was predicted 3 months in advance, and as stated, 85 percent of the larval population was bollworm. The occurrence of the F_2 and F_4 Heliothis generations was accurately predicted.

Contact: E. G. King

SR-80-3 - Biological control of three weeds in rice, soybean, and cotton with fungal disease combinations - Stuttgart, Arkansas. The objective of the study

is to manipulate three mycoherbicides (Colletotrichum gloeosporioides f. sp. aeschynomene, C. gloesporioides f. sp. jussiaeae, and C. malvarum) in weed management systems to control northern jointvetch, winged waterprimrose, and prickly sida in rice, soybean, and cotton.

Colletotrichum gloeosporioides f. sp. aeschynomene has been registered by Upjohn as Collego®. No infection or chronic symptoms were observed in animals treated with the fungus. These included rats, mice, rabbits, guinea pigs, dogs, turkeys, chickens, quail, ducks, crayfish, perch, catfish, frogs, and earthworms.

The fungus can be mixed with acifluorfen, a chemical herbicide that controls hemp sesbania. Practical recommendations for the use of the fungus have been developed.

Contact: R. S. Smith

SR-80-5 - Evaluation of cotton cultivars with resistance to bollworm, Heliothis zea; tobacco budworm, H. virescens; and boll weevil, Anthonomus grandis - Florence, South Carolina. Three breeding lines, PD 695, PD 875, and PD 8619, with resistance to Heliothis spp. were compared with a very early breeding line, PD 6520, and mid- and full-season check cultivars, McNair 220 and Coker 310, for lint yield and insect responses under three insecticide regimes. Based on damaged squares and live insects on July 8, both the high rate (0.11 kg AI Pydrin + 0.27 kg AI Guthion/ha) and low rate (0.056 kg AI Pydrin + 0.27 kg AI Guthion/ha) of application were used at 2- to 6-day intervals for boll weevil and Heliothis spp. control in a large plot test (24 rows, 96 cm apart, and 20 m long).

The threshold of 10 percent square damage and/or 2 percent live larvae for Heliothis spp. was not found on PD 695, for which the rate (0.11 kg AI Pydrin + 0.27 kg AI Guthion/ha) was proposed. However, plots were sprayed on July 22 and 11 times afterward at 2- to 5-day intervals because boll weevil infestations ranged from 2.7 percent on PD 695 to 23.5 percent on PD 875,

The insecticide regimes required to control boll weevils kept Heliothis spp. below economically tolerable threshold levels in all plots; therefore, it was not possible to evaluate the reaction of resistant PD lines to Heliothis spp. There were no significant differences in seed cotton yields between the high and low insecticide regimes. The low rate of insecticide that previously failed to control Heliothis spp. has been satisfactory for the past 2 years. The wide use of synthetic pyrethroids may have reduced the population of Heliothis spp. in the area.

Loss of seed cotton between optimum and minimum treatments was less on PD 695 than any other normal bract cultivar. Listed in order of increasing loss are: PD 695, -354; Coker 310, -678; PD 8619, -1057; PD 6520, -1080; and PD 875, -1089 kg/hr. Since Heliothis spp. square damage and live larvae were similar under all insecticide regimes, these yield differences were probably due to boll

weevil damage. The superiority of PD 695 is attributed to its frego bract character.

Contact: R. F. Moore

SR-80-7 - Biological control of mosquitoes breeding in containers - Gainesville, Florida. The first year of this study demonstrated that the species Toxorhynchites rutilis rutilis could not effectively control Aedes aegypti in a test area of New Orleans because it did not find enough containers with breeding mosquitoes. Therefore, the second year was devoted to evaluating a new species, T. amboinensis. Liberations of laboratory-reared males and females resulted in oviposition in virutally every type of container found in the area of release; and oviposition was largely independent of the color of the container and its proximity to vegetation and buildings. Between May and October, fecundity, the duration of oviposition following a release, and the proportion of containers with both prey larvae and predator females declined with decreasing numbers of females released and decreasing rate of release. Indications are that the predator females oviposit in response to cues correlated with the presence of prey immatures and that ephemeral habitats such as containers that tend to dry out are not attractive as oviposition sites.

This year, the third year of the study, work is being done primarily with T. ambionensis in a selected block area of New Orleans. Adults are being released at the rate of 100 per week. The presence of the predator and the reduction of both Aedes aegypti and Culex quinquefasciatus are being monitored by two independent methods, in oviposition traps and by examination of artificial containers. Migration of predator adults from the treatment area is also being monitored. Control of A. aegypti biting population reached 60 percent after the start of releases, while control of C. quinquefasiatus was only 35 percent due probably to reinvasion. The test will be continued through the remainder of the summer; and different patterns and numbers of release will be used to determine their effects on the degree of control, once effective control has been demonstrated. A final test on a larger area is planned for the next and final year of this pilot study.

Contact: D. A. Dame

SR-78-1 - Management of tobacco budworms via their hybridization and concomitant acquisition of sterile trait - St. Croix, Virgin Islands. All production and shipment goals were attained for backcross (BC) and Heliothis virescens pupae. Further, during the all-island release (27 August - 17 December 1980), nearly 45,000 BC pupae were shipped daily for release on St. Croix. For a 6-week period (17 January - 27 February 1981) the frequency of BC males in cone traps was 94.3 $\pm$ 6.24 percent. For that period, a two-way analysis of variance indicated no significant difference among week or sections. A frequency of 94 percent represents a ratio of 17 BC to 1 H. virescens insect. From February to July 1981, the BC frequency dropped from about 94 percent to 65 percent, or at a rate of 1.14 percent per week. At ca. 65 percent, BC frequency leveled off and remained at that level for more than 6 months. A comparison of the 1981 native population on St. Croix with the populations of previous years indicates that

the released backcross suppressed the H. virescens population. Particularly significant is the effect of the release on the normal rate at which H. virescens had been increasing during the spring. The increase was 19-fold for 1978 through 1980, but only 2-fold in 1981. Data from egg and larval collections before and after the all-island release show ca. 75 percent reduction in H. virescens populations on pigeon pea and Bastardia plots. Trap data, sperm transfer data, and host plant sampling data all indicate that the sterile trait was introduced into the native population at a high level and that suppression occurred. The BC level is being monitored through 1982 and the evaluation, continued. Certainly, there is potential for the hybrid sterility in Heliothis virescens management and therefore, it may be applicable to other insect species as well, e.g., the bollworm - Heliothis zea (Boddie).

Contact: F. I. Proshold

WR-82-12 - Water management to control Culicoides variipennis in breeding sites and to reduce incidence of bluetongue - Denver, Colorado. Bluetongue is a serious disease of ruminants throughout the central and southern tiers of states. Mortality in sheep ranges up to 30 percent of infected animals. Abortion and both deformed and unthrifty calves are the most severe results in infected cattle.

Culicoides variipennis, the known vector of bluetongue in ruminants, breeds in shallow mud contaminated with human or animal wastes. In the South Platte River basin these breeding sites are almost invariably associated with poor management of water resources, which is frequently coupled with poor waste management practices. The primary objective of the proposed research is to permamently destroy breeding sites within a finite study area by such water management techniques as installing underground interceptor drains and improving surface drainage. If this objective is gained, both C. variipennis populations, and the incidence of bluetongue will be reduced; and the reductions will be more long term, economic, and safe for both humans and the environment than they would be if pesticides alone were used. The necessary funding level for the proposed 3 years of study is $343,300.

Experimental areas of 36 to 100 square miles have been selected for pilot testing; four are in northeastern Colorado and two each are in northwestern Nebraska. Because of previous work done in Colorado areas, supression efforts are being carried out in the area west of Brighton, while an area near Johnstown and Milliken is being monitored as a control. The two areas in Nebraska, one near North Platte and the second near Whitman, are being surveyed by ground crews for larval development sites, and by light traps and vehicle mounted traps for adult C. variipennis activity. Supression of C. variipennis will be undertaken in one of the Nebraska areas beginning with the 1983 season.

Contact: F. Holbrook

WR-81-1 - Pest management with short season cotton - Phoenix, Arizona. The pink bollworm and other mid- to late-season pests in 1977 caused an estimated $135

million in damage to the cotton crop in Arizona and the Imperial Valley of California, in spite of multiple applications of insecticides and recommended planting and plow-down dates. Applications of insecticides to control pink bollworms have reduced their parasite and predator populations and have thus aggravated tobacco budworm, corn earworm, and cotton leafperforator problems.

The objective of the pilot study is to develop an alternative cultural and pest management system that would involve the production of a cotton crop with satisfactory fiber yield, seed yield, and quality before pest populations reach economically unacceptable levels during the growing season.

The approach is to (1) plant the cotton in rows that will maximize the rates at which the leaf canopy can intercept and utilize solar energy, and (2) control the pink bollworm and other cotton insects by an integrated system of pest control technology that includes pheromone applications to disrupt mating, nectariless cotton, in-season applications of microbial and other insecticides, late-season chemical application to prevent cotton from fruiting, and winter irrigation.

Tests were initiated at the Imperial Valley Conservation Research Center, Brawley, California, in the spring of 1982. Cotton seed was planted in plots 30- and 40-inch rows (4 reps of each, total of 8 acres). In June and July, all plots will be treated 4 times at 14-day intervals with the pheromone Nomate PBW, as mandated by the Imperial Valley Pest Control District. At the end of the pheromone program, plots will be split, and one-half of each plot will be treated with insecticides to surpress populations of the pink bollworm and other insect pests to economically tolerable levels. The remaining half will be untreated. Each plot will be resplit so that each half will have an insecticide treated portion and an untreated portion; and in late August to early September, fruiting in one of the halves will be chemically terminated to determine the effect of that action on diapause pink bollworm larvae.

During the season standard boll samples, pheromone trap records, and terminal counts will be taken to monitor insect populations. Plant sampling will be initiated to determine the effect of plant growth regulators on cotton fruiting and all plots will be machine picked to determine the effects of the various treatments on yield.

Contact: T. J. Henneberry

WR-80-2 - Impact from management of cover crops, weeds, and pesticides on the ecology and regulation of citrus thrips - Riverside, California. Empirical field and laboratory observations have confirmed the beneficial role of the phytoseiid mite, Euseius hibisci, toward regulating the injurious early generations of the citrus thrips. Upwards of 2,000 acres of citrus in the Corona foothill area of Southern California received no citrus thrips sprays. The discovery of natural resistance by E. hibisci to insecticides from the San Joaquin Valley and its genetic potential for conferring resistance through hybridization of geographic strains throughout the Southwest is potentially pivotal to the successful implementation of regional citrus IPM programs; this, especially where California red scale is not under adequate biological control.

Contact: D. Moreno

WR-77-1 - Integrated weed control, seeding technology, and grazing management of sagebrush grasslands - Reno, Nevada. Western rangelands are for the most part abused and today are unstable and low producing. They must be improved and grazed so that they will be productive in terms of red meat and wildlife and will have soil-surface characteristics that will resist erosion.

Brush and weed control technologies coupled with seeding methodologies (including seedbed preparation and planting of adapted species) have been developed for improving intermountain rangelands. Evaluation of various grazing management systems has been initiated, but the findings for western rangelands are still preliminary.

The objective of this pilot study is to evaluate and compare various range improvement technologies (brush and weed control and seeding) to integrate these with grazing management systems, and to evaluate the effects of improved and unimproved rangelands management under different grazing systems on forage production, stability of plant communities, cattle production, wildlife habitat, and watershed characteristics.

The range improvement/grazing management systems are being evaluated on the Gund Ranch, a working cattle ranch owned by the University of Nevada. The ranch, comprises two distinct series of rangeland communities: Great Basin Wildrye, which grows on saline/alkaline areas, and salt tolerant grasses. These communities are found on rangelands that are typically degraded and dominated by the brush species greasewood, rabbitbrush, and sagebrush.

In tests to date brush was controlled 100 percent by burning, 74 percent with 2,4-D applied at the rate of 2.2 kg/ha, and 61 percent with two-way plowing. Excellent stand of crested wheatgrass was established (4 seedlings/m of row) in a dry year. Jackrabbit damage was severe.

An ARS-WR bulletin on the prototype sagebrush sprayer was published. A foam marker system that is effective on sagebrush rangelands was developed and tested for the sprayer.

Soils and vegetation on alluvial fans at the Gund Ranch were geomorphologically delineated by use of aerial photos. Four major divisions were made: (1) alluvial fans, (2) interfan valleys and channels, (3) lagoons, and (4) offshore bars. Discriminant analysis separated (90 percent accuracy) the four major divisions by % gravel, % sand, and available NO_3.

Forage production curves indicated that improved rangelands (brush control and seedings) yielded 550 kg/ha of forage in June whereas check areas yielded 10 kg/ha. Much useable forage early in the season was downy brome, but crested wheatgrass contributed most to the forage base later.

Contact: R. Evans

WR-77-2 - Comprehensive study of rehabilitated range ecosystems in the Southwest - Las Cruces, New Mexico. Mesquite and creosotebush have invaded and drastically reduced the productivity on 139 million acres of arid rangeland in the Southwest. Even though local economies have been adversely affected by the reduction in livestock numbers resulting from this brush invasion, there has been little application of available technologies for brush control.

The objectives of this study, which involves controlling mesquite chemically and creosotebush by rootplowing and reseeding, are to (1) obtain accurate estimates of range improvement costs, (2) determine the production of livestock on improved range, (3) determine the environmental impact of range restoration measures, (4) determine the mobility of herbicides within natural systems and determine whether toxic pesticides or derivative compounds may concentrate at some point in ecosystem food chains, and (5) provide quantitative data leading to the identification of grazing and management strategies that will maximize livestock production while maintaining the stability of altered ecosystems.

Plant production was determined on sprayed and nonsprayed areas. In the fifth season (1980) following treatment of a 3,634-ha site with 2,4,5-T, (1) total grass and forb production was 472 kg/ha as compared with 305 kg/ha on the control area; and (2) perennial grass production was 85 percent less than in the fourth season (1979) on the sprayed area and 89 percent less on the control area. A final evaluation of mesquite kill on the sprayed area, showed that stem kill of mesquite was erratic, ranging from 17 to 66 percent and averaging 37 percent at the locations sampled. Stem kill on north exposures of dunes was significantly higher (47 percent) than kill on west (33 percent), south (31 percent), and east (38 percent) exposures. A comparison of dune and interdune soils showed that pH, electrical conductivity, organic matter content, and bulk density were not substantially different. However, dune soils were coarser, had higher hydraulic conductivity rates, lower temperatures, and lower water retention and availability than interdune soils. In spite of a greater evaporation potential, interdune soils showed a consistently greater water availability than dune soils during two growing seasons.

Relationships were determined between plant growth and environmental factors. A data acquisition system recording soil and air temperatures, soil-water and wind velocities, and total radiation was operated at a nonsprayed mesquite dune site. Observations were made at weekly intervals to record the phenological development of mesa dropseed, broom snakeweed, mesquite, fourwing saltbush, and one perennial forb. Amount and timing of precipitation appeared to be the dominant factor influencing phenological development of all species.

Alternative herbicides were evaluated. Five-hectare plots infested with mesquite had aerial applications of 2,4,5-T, Dowco 290, Dowco 290 + 2,4,5-T, and Dowco 290 + picloram. A 130-ha area infested with creosotebush was aerially treated with 0.5 kg/ha tebuthiuron pellets and will become part of a large area to study treatment responses. The plots aerially treated with 0.6, 1.1, and 3.3 kg/ha of tebuthiuron pellets in 1979 had creosotebush root kills of 93, 97, and 99 percent, respectively, while all the tarbush plants were killed. The plots treated with 0.6, 1.1, and 1.5 kg/ha of picloram granules had creosotebush root kills of 4, 19, and 28 percent, respectively, while the tarbush kills were

estimated at 20, 50, and 30 percent respectively. The plots aerially treated with 1.5, 2.2, and 3.0 kg/ha tebuthiuron had mesquite root kills of 95, 98, and 99 percent, respectively. The plots aerially sprayed with 0.6 kg/ha 2,4,5-T, 0.3 kg/ha 2,4-D + 0.3 kg/ha dicamba, 0.3 kg/ha picloram + 0.3 kg/ha dicamba, 0.3 kg/ha triclopyr + 0.6 kg/ha picloram, and 0.6 kg/ha of a mixture of 2,4-D, 2,4-DP, and dicamba had mesquite root kills that averaged 44 percent. Mesquite kills on the remaining plots averaged 11 percent. These data suggest that less than 0.6 kg/ha tebuthiuron pellets is effective in controlling creosotebush and tarbush while less than 1.5 kg/ha is an effective control on areas infested with honey mesquite.

Comparisons were made of rodent, bird, insect, and soil microorganism populations on sprayed and control areas. A final report of bird studies conducted by a collaborating scientist from the New Mexico State University was prepared. Number of bird species was somewhat higher on nontreated areas than on sprayed areas. In the dune habitat, from 19 to 26 species were observed on census transects in the untreated area during 1979 and 1980. In the sprayed dune habitat only 16 to 20 species were encountered. Flat, nonduned mesquite areas supported fewer species than did duned areas. Differences in diversity, regularity of occurrence, and breeding status were relatively minor between treated and nontreated habitats. A paper covering populations of mesquite leaftiers (Lepidoptera) on sprayed and nonsprayed areas was prepared for publication.

Contact: C. H. Herbel

PRINCIPAL CONTACTS - SRP: Pilot Tests

Fresno, California -

P. H. Van Schaik
Assoc. Area Director
California - Hawaii Area
Western Region, ARS, USDA
2021 S. Peach Ave.
P.O. Box 8143
Fresno, CA 93727
Tel.: 209-487-5351
FTS: 467-5351

Gainesville, Florida -

D. F. Davis
Area Director
Florida-Antilles Area
Southern Region, ARS, USDA
P.O. Box 14565
Gainesville, FL 32601
Tel.: 904-373-6701
FTS: 947-7250

West Lafayette, Indiana -

E. D. Gerloff
Asst. Area Director
Illinois-Indiana-Ohio Area
North Central Region, ARS, USDA
National Soil Erosion Lab., Bldg. Soil
Purdue University
W. Lafayette, IN 47907
Tel.: 317-743-0011
FTS: 331-6001

Ithaca, New York -

J. B. Wilson
Area Director
North Atlantic Area
North Central Region, ARS, USDA
P.O. Box 849
Ithaca, NY 14850
Tel: 607-256-6561

Special Research Program

INTEGRATED PEST MANAGEMENT SYSTEMS

Technological Objective 1: Combine two or more pest suppression methods into practical systems of integrated pest management (IPM) to reduce pest problems in crop production, animal production, marketing, and human health and safety.

NPS Contact: Waldemar Klassen

Research Locations:

Note: Scientists at various locations submit systems research proposals in order to compete for funding from the Administrator's IPM Systems Funds of $1.1 million per year. Projects at the following locations are currently funded:

Fort Collins, Colorado
Gainesville, Florida
W. Lafayette, Indiana
Orono, Maine
Stoneville, Mississippi
Ithaca, New York
Weslaco, Texas

Examples of Recent Progress:

IPMS-NER-80-1 - Integrated systems for managing potato pests - Orono, Maine. 1980-1984. Contact S. S. Leach

The objectives of this research are to develop an integrated system for managing white potato pests, including weeds, insects and diseases. In 1981 we showed that the denser the crop canopy of white potatoes the better the weed control and the higher the relative humidity in the microenvironment within the canopy. This higher RH did affect disease spread somewhat. The inclusion of a crop resistance factor into Blitecast has provided excellent results in reducing the amount of fungicide needed as well as the number of sprays required to control late blight. The program is now being modified to include early blight. (In cooperation with Maine Agricultural Experiment Station and New York Agricultural Experiment Station.)

IPMS-NCR-80-1 - An IPM system for crop production in the Eastern Corn Belt region - West Lafayette, Indiana. FY 1980-1984. Contact: M. M. Schreiber

The proposed research goal is to investigate the interactions of crop rotations and tillage systems common to the Eastern Corn Belt region in relation to the most practical, economically feasible, and environmentally compatible integrated pest management systems on yield and quality of different crops. The

interdisciplinary, long term approach will be to: (a) study the population dynamics of the most comon pests (diseases, nematodes, viruses, insects, and weeds) and to quantify their influence on the quality and quantity of the crops studied; (b) develop and assess new tactics for the management of populations of these pests in the systems studied; (c) make economic analysis of the emerging integrated pest management systems; (d) determine the energy efficiency of the integrated pest management systems; (e) determine the merits of the systems studied in relationship to the maintenance of soil productivity and conservation; and (f) evaluate soil fertility management in multiple cropping and tillage systems and soilborne pathogenic organisms on the mineral nutrition of crops studied.

Weed Science:

Within 2 years we developed three levels of weed pressure by the selection of weed management systems (WMS) involving cultural and chemical methods of control. These levels are essential for the studies of the interactions of weeds, insects, and diseases, one of the main objectives of this SRP-IPM. Weed populations were directly related to the crop rotations and tillage systems studied. Corn following soybeans had higher weed levels than continuous corn, with no-till having the highest weed pressure within WMS. However, continuous soybeans had higher weed levels than soybeans following corn, with chisel tillage having the highest weed pressure within WMS. Within minimum weed management levels, no-till produced the lowest yield of soybeans regardless of crop rotation. Continuous soybeans produced significantly lower yields than soybeans following corn, which correlates well with weed data.

Plant Pathology:

In corn, higher lesion nematode counts were associated with higher weed populations. This was not evident in soybeans or wheat. Lesion nematodes extracted from weeds ranked in descending order of their ability to support reproduction are: lambsquarter, johnsongrass, jimsonweed, giant ragweed, and giant foxtail.

Preliminary data indicate that wheat diseases can be more prevalent under minimum tillage where infected stubble can be a primary source of inoculum.

Pod and stem colonization of soybean blight was more severe in plots where excessive weed development occurred. Data confirm that high rates of trifluralin and vernolate used for johnsongrass control favor increased establishment of charcoal rot fungus on soybean roots.

Entomology:

Black cutworm damage significantly increased as tillage decreased in corn plots and appeared to be related to crop rotation and weed management, being favored in no-till, continuous corn, and minimum weed conrol. Minimum tillage favored significantly more corn rootworm damage in untreated than in insecticide treated plots of corn following soybeans.

In soybeans, flea beetles and flower bugs were more numerous in the minimum weed management plots, whereas nabids were more numerous in maximum weed management plots.

Population monitoring of the bird-cherry-oat aphid, a major vector for barley yellow dwarf virus (BYDV), indicates aphid movement from wheat during the growing season to volunteer wheat following harvest (Aug. to Sept.), to corn (Sept. to Oct.) and back to fall wheat in late Sept. through Nov. These data are based on actual aphid counts and BYDV infestation is based on results of ELISA tests.

Agric. Econ. and Engineering:

Computer software and procedures were developed to translate field environmental data as recorded by a microprocessor-based data acquisition system into edited and validated files. Economic analyses for various combinations of tillage, crop rotation, and WMS were initiated by using versions of farm planning models developed at Purdue.

IPMS-SR-80-1 - IPM systems for horticultural crops - Weslaco, Texas.
FY 1980-1983. Contact: C. M. Heald

A new postharvest basal rot disease of onion caused by an unidentified fungus was observed. Fungicide (chlorothalonil) applications to control foliar diseases in the field have a beneficial carry-over effect on postharvest quality. Sprouting, Aspergillus rot, and basal rot were significantly less in onions receiving field applications of fungicide than in onions receiving no treatment. In contrast, herbicide and nematicide applications significantly increased the incidence of Aspergillus rot. Preliminary evidence suggests that the lush growth of onions receiving the herbicide and nematicide may have contributed to increased Aspergillus rot. For the first time ever, incidence and importance of Botrytis rot on the Texas onion has been demonstrated.

Rotylenchulus reniformis was the primary plant-parasitic nematode. Nematode numbers before soil fumigation and planting of onion were not affected by previous treatments. Numbers of R. reniformis were significantly less, however, after application of a nematicide 2 weeks before planting of onion. There was no significant increase in numbers of R. reniformis in nematicide plots throughout the onion growing season. Application of a nematicide significantly increased the final plant stand, total weight and number of marketable bulbs, and weight and number of culls and #2 onions. There was an apparent herbicide-nematicide interaction. Without either the nematicide or herbicide, yields were suppressed; with either chemical alone, yields significantly increased. However, onions treated with the nematicide and herbicide in combination did not yield as well as when the chemicals were applied singularly.

The western flower thrips, Frankliniella occidentalis (Pergande), was identified as the primary insect pest of onions. Four applications of ethyl parathion significantly reduced thrip populations in threatened plots, but reductions were

short lived and populations continued to increase with an average of 2-10/plant. A final application of malathion did not significantly reduce populations. Because the thrip populations noted in this study were not a limiting factor affecting yield, the five applications of insecticides could be reduced or eliminated without economic loss to the producer.

Weed seedling populations in onions were efficiently controlled only by the herbicide or by a herbicide-pesticide combination, not by hand-weeding or cultivation. Weed populations reduced the stand and eliminated yields of onions. Significant yield increases of marketable onions occurred with herbicide (H), insecticide (I), nematicide (N), HI, HN, IN, and HIN. Hand-weeding cost $480/A and weed control by herbicide (including labor and equipment) $159/A, a savings of $321/A or 67 percent with herbicide.

A serious epiphytotic of purple blotch disease occurred. Onion plant growth conditions were highly conducive to epiphytotic development. Plots under the regular spray program received 13 applications of chlorothalonil, whereas plots under the leaf wetness program received 10. Those plots receiving no fungicide were 70-90 percent defoliated. The highest amounts of leaf necrosis and rates of disease increase were in the nematicide and herbicide treatments receiving no fungicide. No significant differences between two programs were evident in either amount of leaf necrosis or rate of disease development. Thus, comparable disease control can be obtained with fewer fungicide applications. No significant differences in either quality or quantity of bulbs were found between the regular spray program and the leaf wetness program.

IPMS-SR-80-3 - An IPM system for dog fly and other filth-breeding flies - Gainesville, Florida. FY 1980-1983. Contact: R. S. Patterson

Surveys were continued on the seasonal abundance of both immature and adult dog flies in northwest Florida. Counting the number of flies per animal and operating attractive traps has produced seasonal density curves for adults in the area for an entire year, basic data needed for the project. Major breeding sites for the immature flies have been located and mapped. The type of breeding media, e.g. waste rolled hay, most important to the production of flies has been identified, and farming practices resulting in fly production have been determined.

Studying the dispersal and migratory patterns of this fly in Florida has been a continuing effort. A new self-marking technique was developed. The method permits marking individuals of the wild population automatically. By placing these marking devices in different geographical locations and by using different colors to define the location, it is now possible to determine the source of flies at long distances, particularly the coastal beaches. Initial results have shown movement exceeding 100 miles, from agricultural areas to coastal beaches. Studies of migration and source of flies will be continued.

Methods of identifying the blood sources of these flies have been developed and genetic techniques for studying population variability are being developed.

IPMS-WR-80-1 - Systems approach to IPM in irrigated crops - Fort Collins, Colorado. FY 1980-1984. Contact: E. E. Schweizer

A 6-year pilot test study was recently concluded at Fort Collins, Colorado, which determined how quickly the number of weed seeds in irrigated soil could be reduced in two crop rotations of barley, corn, and sugarbeets treated with herbicides. This system was compared with a system in which herbicides were applied for 6 continuous years in corn. The overall decline in the total number of weed seeds in both systems of management was 98 percent.

Further, only a few weeds survived the cultural and chemical treatments and produced seeds during the first 5 years in either management system, and no weed seeds were produced after 6 years of continuous weed control. With the rotational crops, weeds were controlled more effectively with the most intensive herbicide systems. However, more weeds escaped in rotational crops than in continuous corn; thus, the total decline in the number of weed seeds per acre was less because more weed seeds were produced each year. During the 6th year, weed production in barley, corn, and sugarbeets was 1.8, 2.7, and 17.3 times greater in the system that received the least herbicides as compared with the system that received the most herbicides. For the system that received the least herbicides, weed counts were 227,000 weeds/A in barley, 3,350 weeds/A in corn, and 8,230 weeds/A in sugarbeets.

Results from this project have led us to conclude that while weed control is required each year, intensive herbicide usage is not. Therefore, additional IPM research was initiated in 1981 at Akron and Windsor, Colorado, to assess the impact of weed control systems on the management of pests (insects, nematodes, pathogens, and weeds) in a surface-irrigated barley-bean-corn-sugarbeet rotation in central Colorado, and the impact of weed control systems and tillage methods on the management of pests in continuous corn grown under center pivot irrigation in eastern Colorado.

Objectives:

(1) Quantify the effects of specific integrated weed management systems (IWMS) on the incidence of insect, disease, and nematode problems in a barley-bean-corn-sugarbeet rotation and in continuous corn; (2) determine base populations of potential soilborne pathogens in IWMS field plots; (3) survey diseases occurring in crops of IWMS field plots; (4) determine the effects of crop rotation, tillage practices, and IWMS on insect populations in each crop; and (5) determine the effects of crop rotaion, tillage practices, and IWMS on the total weed seed population in soil.

Progress:

Most weeds were controlled satisfactorily in all crops with herbicides. However, toothed spurge escaped control in barley and sugarbeets and may become a more serious problem in the future. Volunteer corn was the major "weed" problem in the minimum-till plots where corn will be grown continuously.

Based on our monitoring programs, we applied an insecticide only in barley when greenbug approached an economic threshold level. No nematicide was used in sugarbeets, even though there were low populations of the sugarbeet cyst nematode in most plots. At the end of the growing season, the sugarbeet cyst nematode populations increased to the extent that if we were to grow sugarbeets in the same field the following year, we would have to apply a nematicide.

Base populations of potential soilborne pathogens were established at both locations. No serious disease problems were encountered in any crop during the season, although spot blotch of barley, sclerotinia white mold of bean, beet mosaic and rhizoctonia root rot of sugarbeet, and common smut and rust of corn were observed in the plots during the year.

Yields of all crops were excellent, with no major differences in yields occurring between herbicide intensity levels.

PRINCIPAL CONTACTS - SRP: IPM Systems

Oakland, California -

H. P. Binger
Asst. Regional Administrator
Program Planning and Review
Western Region, ARS, USDA
1333 Broadway, Suite 400
Oakland, CA 94612
Tel.: 415-273-7192
FTS: 536-7192

Peoria, Illinois -

T. J. Thiel
Asst. Regional Administrator (Acting)
Program Planning and Review
North Central Region, ARS, USDA
2000 West Pioneer Parkway
Peoria, IL 61614
Tel.: 309-671-7172
FTS: 360-7172

New Orleans, Louisiana -

M. H. Frere
Asst. Regional Administrator
Program Planning and Review
Southern Region, ARS, USDA
701 Loyola Ave.
P.O. Box 53326
New Orleans, LA 70153
Tel.: 504-589-6349, Exts. 6333 & 6339
FTS: 682-6349

Beltsville, Maryland -

J. R. Dogger
Asst. Regional Administrator
Program Planning and Review
Northeastern Region, ARS, USDA
Bldg. 003, BARC-West
Beltsville, Maryland 20705
Tel.: 301-344-2783
FTS: 344-2783

Special Research Program

MINOR USE PESTICIDES

This Special Research Program is intended to improve availability of pesticides that are needed for minor and special uses. Such pesticides are used for production of crops and livestock and for protection of commodities during storage and distribution and in marketing channels. Minor-use pesticides prevent losses of fruits, vegetables, and other agricultural commodities and increase the efficiency of their production by growers, including small farmers, and homeowners. Entomologists, plant pathologists, weed scientists, chemists, and nematologists work in teams to develop the data required to register minor-use pesticides.

Technological Objective: Develop data for use in registration of pesticides for minor crops, minor uses on major crops, and speciality uses.

NPS Contact: P. H. Schwartz

Research Locations:

Denver, Colorado
Byron, Georgia
Savannah, Georgia
Tifton, Georgia
Urbana, Illinois
Vincennes, Indiana
Beltsville, Maryland
Frederick, Maryland
Delaware, Ohio
Wooster, Ohio
Corvallis, Oregon
Charleston, South Carolina
Weslaco, Texas
Logan, Utah
Prosser, Washington
Yakima, Washington
Kearneysville, West Virginia

Examples of Recent Progress

Significant progress made in developing data to support registrations of minor uses of pesticides - Nationwide. Scientists in ARS cooperated with 21 state scientists on 82 food-use requests and 471 ornamental-use requests during 1981. From this total, 33 food-use projects and 140 ornamental-use projects were completed thus far. The IR-4 program currently has a backlog of about 600 food requests and receives 200 new researchable projects a year.

About 1861 ornamental requests have been assembled into data packages by the IR-4 staff. Thus far 1293 registrations have been developed for ornamentals.

Pesticides control fungi and nematodes on vegetables - Tifton, GA. Benomyl and Nemacur were evaluated for control of fungi and nematodes, respectively, on three vegetable crops. Efficacy data have been submitted to IR-4 Headquarters, and samples for pesticide residue analyses have been sent to appropriate laboratories. The data will support applications for registration for use of the pesticides on minor crops.

Method developed for application of herbicides to container-grown nursery stock - Tifton, GA. Seven herbicides at two rates are being applied through the irrigation system at 60-day intervals to 3,000 container-grown plants. Weed control and crop tolerance are equal or better than those in previous tests with granular formulations. With this technique, costs of herbicide and application would be reduced by 50% or more. For use of this method of application a nursery must have an irrigation system that would distribute the herbicide uniformly.

Chemicals control blackvine weevil larvae - Wooster, OH, Yakima, WA. With the loss of chlordane, nursery industries had no viable means of controlling blackvine weevil, which causes heavy losses to certain ornamental and food crops. Through intensified State/Federal research efforts, four insecticides that control weevil larvae were found. Efforts are underway to develop data to support the registration of bendiocarb, carbofuran, oxamyl, and terbufos for control of blackvine weevil larvae.

Glyphosate registered for use on cranberries - Kearneysville, WV. A method was developed to utilize glyphosate in a belt-wiper application to control weeds in cranberry bogs. In cooperation with state scientists, data were developed to support registration of this use. The cranberry industry estimates that the method increases cranberry yield by 10% and return from the crop by about $15 million per year.

PUBLICATIONS

See also appropriate NRP Listings.

Tifton, Georgia

Glaze, N. C., M. Singh, and S. C. Phatak. 1981. Oryzalin for weed control in container-grown pittosporum, cleyera, gardenia, pampasgrass, liriope, and aucuba. Proc. Southern Nurserymen's Assoc. 26:235.

Johnson, A. W., J. R. Young, and B. G. Mulliniz. 1981. Applying nematicides through an overhead sprinkler irrigation system for control of nematodes. J. Nematol. 13:154-159.

Singh, M., N. C. Glaze, and S. C. Phatak. 1981. Herbicidal response of container-grown rhododendron species. HortScience 16:213-215.

PRINCIPAL CONTACTS

Tifton, Georgia	Dr. Norman C. Glaze USDA-ARS-SR Georgia Coastal Plain Experiment Station Tifton, GA 31794 Tel.: 912-386-3353 FTS: 285-0111
	Dr. Alva W. Johnson USDA-ARS-SR Georgia Coastal Plain Experiment Station Tifton, GA 31794 Tel.: 912-386-3372 FTS: 912-5561
	Dr. Wilbur Rohde USDA-ARS-SR SE Watershed Research Laboratory Georgia Coastal Plain Experiment Station Tifton, GA 31794 Tel.: 912-386-3462
Urbana, Illinois	Dr. Loyd M. Wax USDA-ARS-NCR N325 Turner Hall University of Illinois Urbana, IL 61801 Tel.: 217-333-1277 FTS: 958-9162
Vincennes, Indiana	Dr. David K. Reed USDA-ARS-NCR 1118 Chestnut Street P. O. Box 944 Vincennes, IN 47591 Tel.: 812-882-4942 FTS: 331-7000
Beltsville, Maryland	Dr. J. Feldmesser USDA-ARS-NER Room 154, Bldg. 011A ARC-WEST Beltsville, MD 20705 Tel.: 301-344-3662 FTS: 344-3662

PRINCIPAL CONTACTS - SRP (cont.)

Beltsville, Maryland

Dr. Kenneth R. Hill
USDA-ARS-NER
Room 114, Bldg. 306
ARC-EAST
Beltsville, MD 20705
Tel.: 301-344-2495
FTS: 344-2495

Dr. Ralph E. Webb
USDA-ARS-NER
Room 4, Bldg. 470
ARC-EAST
Beltsville, MD 20705
Tel.: 301-344-2269
FTS: 344-2269

Frederick, Maryland

Dr. J. Ray Frank
USDA-ARS-NER
Weed Phys. & Growth Reg. Unit
P. O. Box 1209
Frederick, MD 21701
Tel.: 301-935-7132
FTS: 935-7132

Delaware, Ohio

Dr. Charles R. Krause
USDA-ARS-NCR
Nursery Crops Research Lab.
P. O. Box 365
Delaware, OH 43015
Tel.: 614-363-1129
FTS: 293-3131 (assistance)

Corvallis, Oregon

Dr. Harrison Dooley
USDA-ARS-WR
Ornamental Plants Research Lab.
3420 S.W. Orchard Street
Corvallis, OR 97330
Tel.: 503-757-4544
FTS: 420-4544

Charleston, South Carolina

Dr. James Schalk
USDA-ARS-SR
2875 Savannah Highway
Charleston, SC 29407
Tel.: 803-677-4746
FTS: 677-4746

PRINCIPAL CONTACTS - SRP 2 (cont.)

Prosser, Washington	Dr. Alex G. Ogg USDA-ARS-WR Irrigation Agricultural Research & Extension Center Prosser, WA 99350 Tel.: 509-786-3454, ext. 264
Yakima, Washington	Dr. John E. Halfhill USDA-ARS-WR 3706 West Nob Hill Blvd. Yakima, WA 98902 Tel.: 509-575-5877 FTS: 446-5877
	Dr. Les. M. McDonough USDA-ARS-WR 3706 West Nob Hill Blvd. Yakima, WA 98902 Tel.: 509-575-5877 FTS: 446-5877